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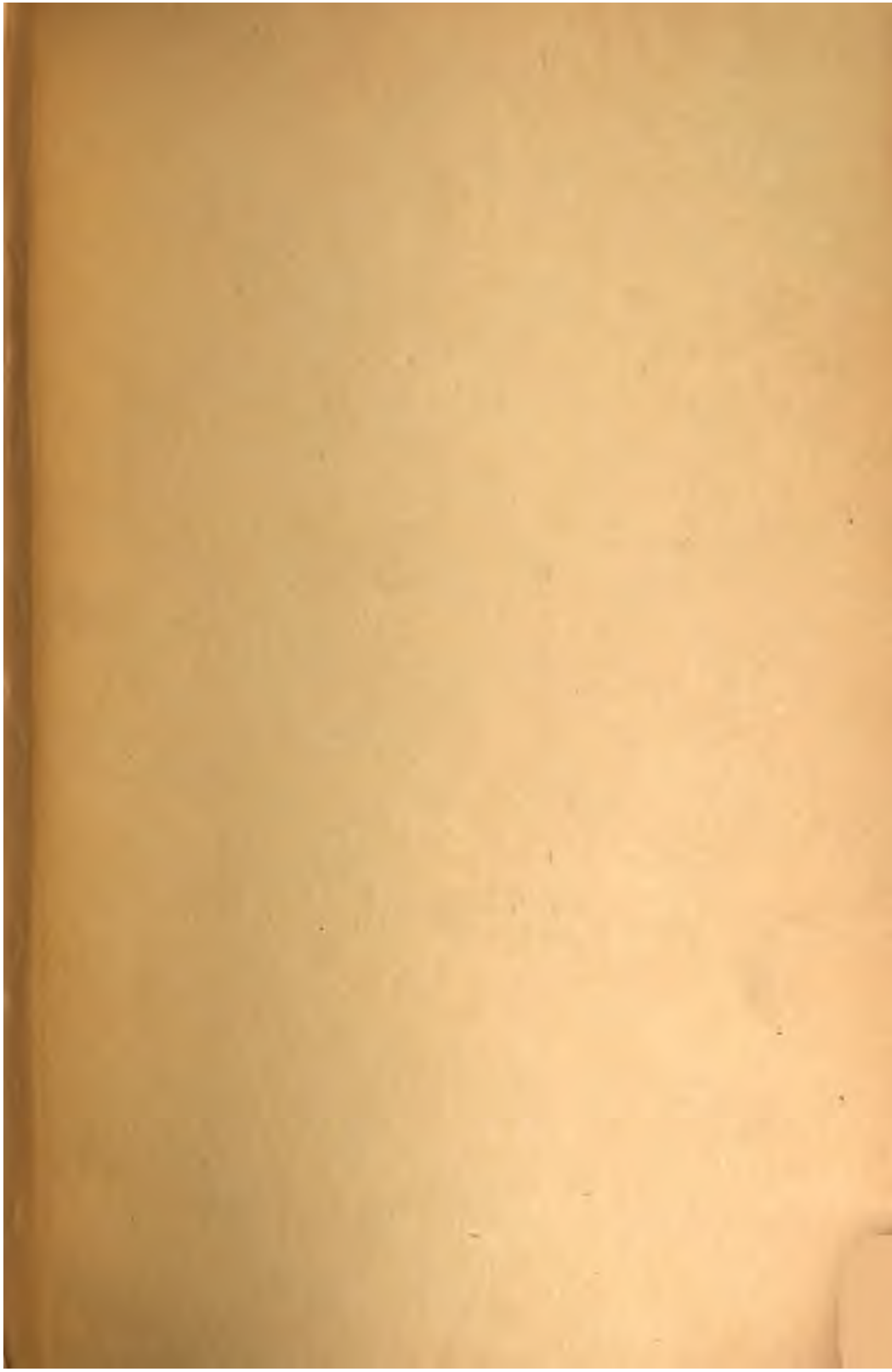
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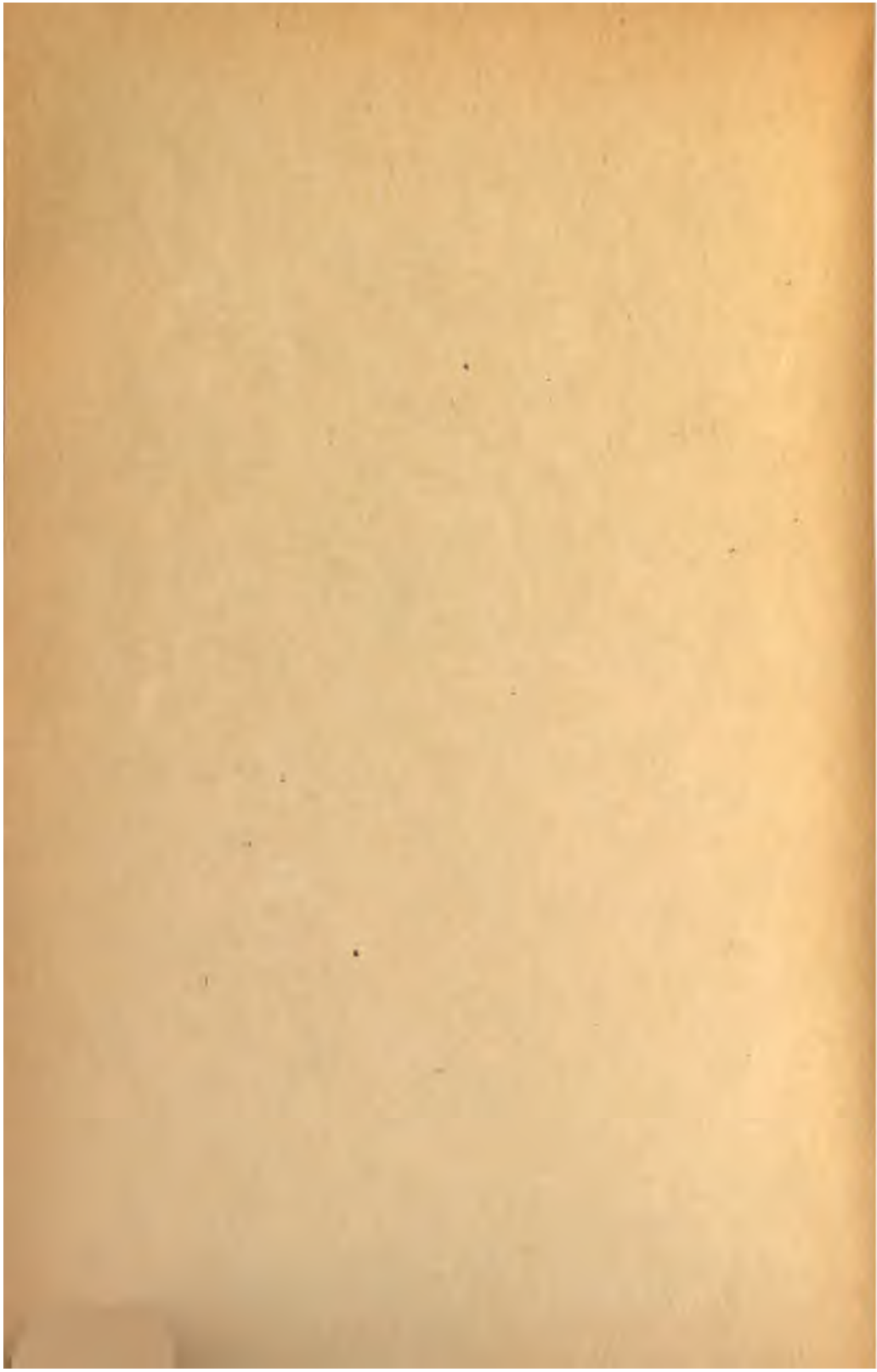


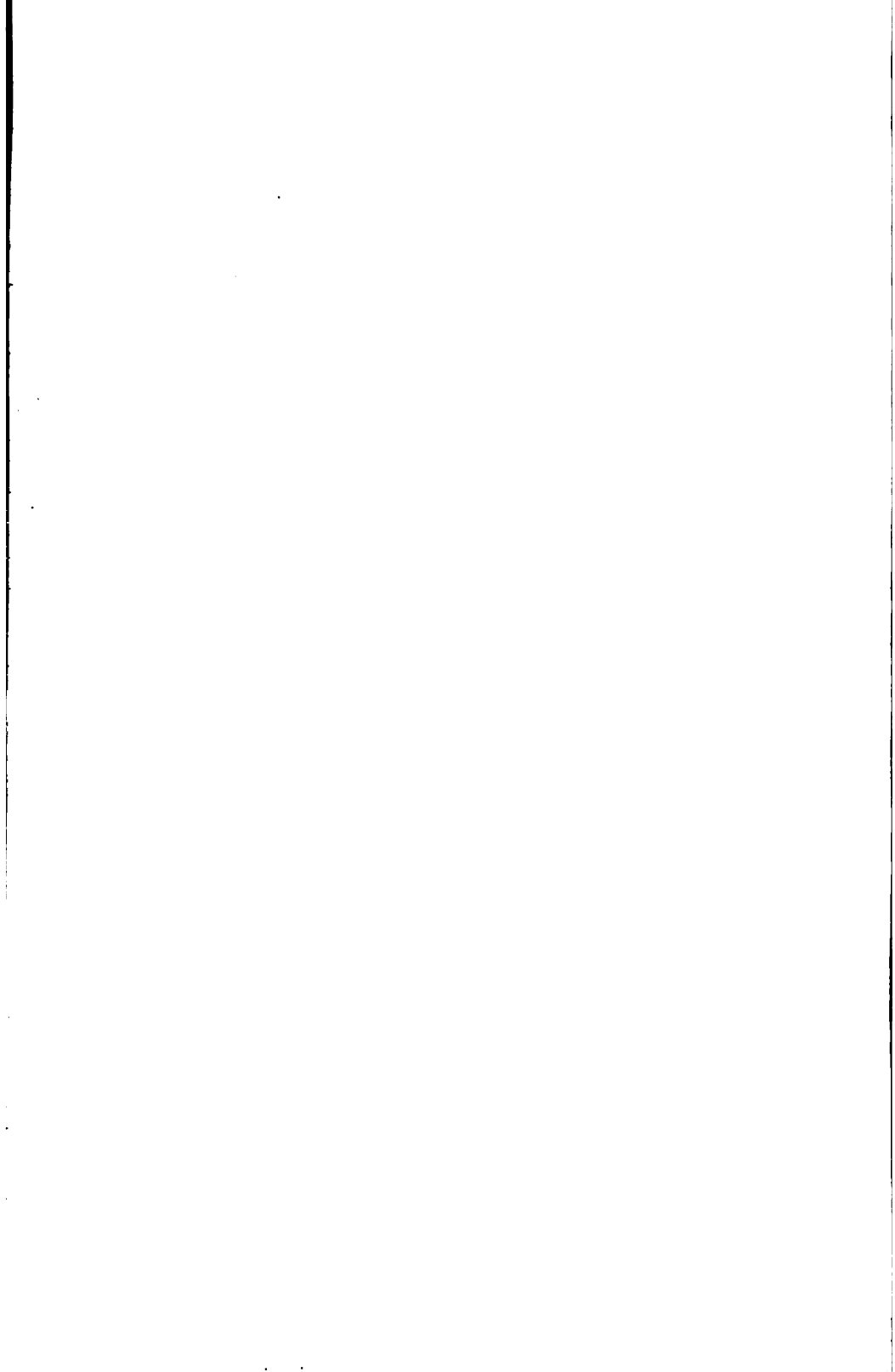
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BULLETIN No. 58.

JUNE, 1899.

HORTICULTURAL DEPARTMENT.

OREGON AGRICULTURAL EXPERIMENT STATION.

CORVALLIS, OREGON.



Rose Culture in Oregon.

BY GEORGE COOTE.

The Bulletins of this Station are sent Free to all Residents of Oregon who request them.

AGRICULTURAL COLLEGE PRINTING OFFICE,
GEO. B. KEADY, PRINTER.
1899.

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100



Plate I—Showing manner of preparing cutting.

Rose Culture in Oregon.

 WING to the number of inquiries as to the general method of the propagation and cultivation of the rose this bulletin has been issued. Not for the purpose of giving information as to the several varieties, but for the sole purpose of giving some practical information on the general methods of cultivation.

There are few plants held in such esteem as the rose. Well may it be termed the Queen of Flowers, as it has a beauty and fragrance which are not found in any other family of plants, and probably there is not another family of plants that so much deserves our attention.

Like most other flowering plants, planted for effect, roses are most effective when planted in groups of distinct colors. To grow a large collection or variety in this way demands a good deal of space unless the groups are very small, and this cannot in many cases be carried into practice. But a mixed border, or bed or two, is within the reach of most owners of gardens, and when the mixed system becomes a necessity for want of space, it must surely be termed a charming necessity, thus forming a pleasing variety. In accordance with the special object of this bulletin, we shall treat briefly on their cultivation as a flower-garden plant, with a few remarks on some varieties that have proved worthy on the college grounds.

PROPAGATION BY CUTTINGS.

Generally speaking, roses for beds are best on their own roots, especially where the soil is inclined to be of a light nature. But in heavy, cold soils, it is preferable to plant those budded on dwarf brier stocks. The perpetuals, Bourbons and China roses succeed in the majority of soils. The propagation of these varieties by cuttings is as easy as the propagation of the currant in the open ground, without any protection whatever. This makes them preferable for all those who wish to propagate their own roses.

From the beginning of October to the middle of November is the best time to propagate these varieties, for the reason that the ground has still some warmth in it; consequently the cuttings soon become calloused, and still continue that process through the winter. The

advantages which fall cuttings have over spring cuttings is this, as already stated: the fall cuttings soon become calloused, and by this means are in a condition to start into growth on the approach of spring, while cuttings placed in the ground in spring very soon begin to make growth, having not had time to callous over, being unable to supply the young growth, as the stored up sap in the cutting is soon thrown off by the young growth, and being devoid of any means to supply the necessary plant life, soon becomes withered and dies out; with but few exceptions, those that do survive make but small growth during the summer, while those inserted in the early fall make fine healthy plants by the following fall, ready to be planted out into permanent positions.

In taking the cuttings those that have well matured their growth, and are strong and straight should be chosen. In taking these from the plant, take with them a slight portion of the previous year's growth; in doing this it may be readily understood how many cuttings should be taken near to each other, being careful not to mutilate the plant too much, whereas a thinning out where they are crowded will prove beneficial. When preparing the cutting, cut the base cleanly through, just where the season's growth has started from, taking with it a thin slice of the former season's growth to form a heel to the cutting; they should be shortened to 15 inches. Those that cannot be had this length may be shortened to 12 or 9 inches. When taking the cuttings, varieties should be kept separate and properly labeled; in this condition they are ready to be placed in the ground. A well drained place should be selected for the purpose, being careful to have the soil made quite light. If not already so, it should be made up to suit. On this will depend success. After the soil has been made ready the cuttings may be inserted up to the second or third bud, placing them in rows, 6 to 8 inches apart in the row and two feet between the rows. This will make cultivation easy, being careful to place the cuttings in the soil firm by pressing the soil about the base. Do not use the foot for the purpose, only the hands, as treading with the foot will cause the soil to become too much packed.

Should the temperature fall below freezing for any length of time, a mulching of short manure placed along the rows and around the plants will be of great benefit to the cuttings; in most seasons this is not necessary. If manure is not on hand, a few evergreen boughs may be laid over them. I would recommend the latter to be done

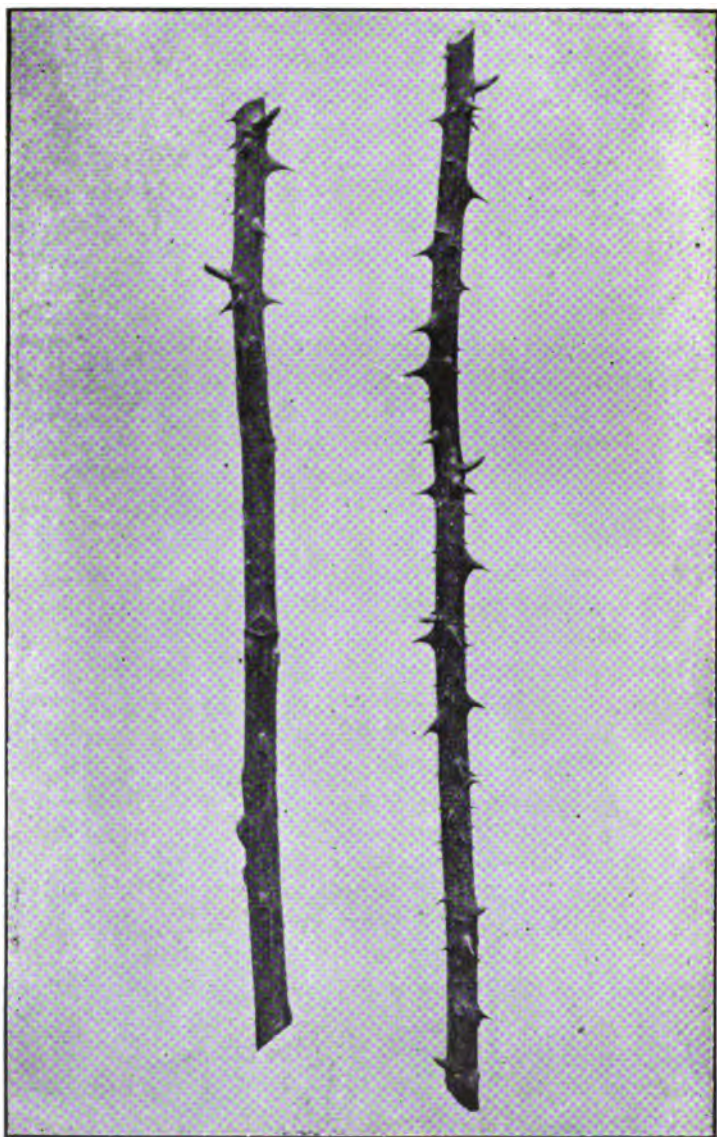


Plate II. Fig. 1—Showing cutting with buds removed.

Fig. 2—With buds intact.

any how; by so doing much sun scalding would be prevented during bright days after a frosty night, and much damage prevented, removing them after all danger of frost is over. Cuttings treated in this manner make beautifully rooted plants by the middle of summer without any other care. An occasional stirring of the surface soil will be of great benefit to the growth of the young plants. In very dry seasons a good soaking of water once a week will be very beneficial. In November the plants will be ready for planting out into beds or borders where they are to remain.

MIDSUMMER PROPAGATION.—As soon as the plants have shed their first crop of bloom, cuttings may be taken from the parent plant the same way as described for fall cuttings, only they need not be so long—about 3 or 4 inches will be sufficient. These should be placed in pots with two or three buds above the surface. Use eight-inch pots, well drained, by placing about two inches of broken brick in the bottom of the pot before putting in the soil. The pots should be firmly filled with a mixture of about equal parts of light loamy soil, leaf mould and sand. The cuttings should not be inserted too thickly in the pots, to cause shade to each other; this will prevent premature shedding of the leaves. If possible they should be placed under the protection of glass, and shaded from the sun, being careful to keep them moderately moist at the root, giving a little air during the night. They may remain for four weeks, or rather until the cuttings have calloused. At this stage if bottom heat from 70° to 80° can be had, the plants will soon start roots. If the latter can not be had they may remain in the former position until rooted. After they are rooted they may either be potted singly in four-inch pots, or they can be potted three or four in six-inch pots, in a preparation of soil as recommended for the cuttings and again placed in a cold frame for a few days, until they become established in the pots, after which they may be planted out in open ground, shading and watering until they become rooted in the soil.

PROPAGATION OF MANETTI STOCKS.—The above cut shows the manner in which the cuttings should be prepared. First select strong, healthy, young, well matured wood. Cut into lengths of about 15 to 18 inches. All buds, except one or two on the upper end of the cutting, should be removed, as shown in cut, by taking the buds clean out with a sharp knife; by so doing much annoyance will be overcome by preventing the growth of suckers in aftergrowth. The two buds left will be sufficient to produce wood for budding.

The cuttings are planted in the early fall, frequently they will make growth strong enough for budding the following fall. Plants that have made sufficient growth may be budded as they stand in the propagating rows. Then in the fall all plants may be taken up carefully, and those that have been budded may be planted out either in beds or borders where they are intended to remain, and those that have not been worked may be reset in nursery rows where they may remain until the next budding season. During the month of March the young growth that has been made the previous year should be pruned back to one bud—next the stem; by so doing stronger growth will be made, which will be the better for working.

PROPAGATION BY BUDDING.—This may be performed in the same manner as for varieties of fruits, excepting that the bud should be inserted on the young shoot or branch as closely up to the main stem as possible. High standard roses are not a success in this climate, for the reason that they are not so easily protected from the frost of winter. Although they may escape and do well for a few years, they are liable to be damaged by hard freezing.

I have grown a few varieties on the native wild rose stock for eight years, but have twice lost them by the sudden drop of temperature, like the one we have just experienced (February, 1899,). Those worked next the ground have escaped, by having a coating of snow to protect them from the direct rays of the sun. Although frozen down to the snow line, they will make strong growth again from below.

The varieties that do well on the native brier are as follows: La France, John Hopper, La Rhine, Glorie d' Dijon, Glorie d' Lyonasse and Queen of Morocco. In the matter of growth of varieties, when budded on the above stock, Glorie d' Dijon loses all of its climbing habit and makes but little wood growth, but produces good sized blooms, and is a free bloomer on this stock. Marechal Niel is short lived, only lasting three or four years.

The common sweet brier makes a good stock for the last-named variety, but should be worked close to the ground, as it makes a much larger growth than the stock; consequently, would be unsightly if above ground. Others, such as the Pillar rose, do not do so and may be worked at any height desired.

PROTECTION.—Roses that are worked close to the ground, also those on their own roots, should be well protected during the winter months by placing evergreen boughs, such as fir, around the plants

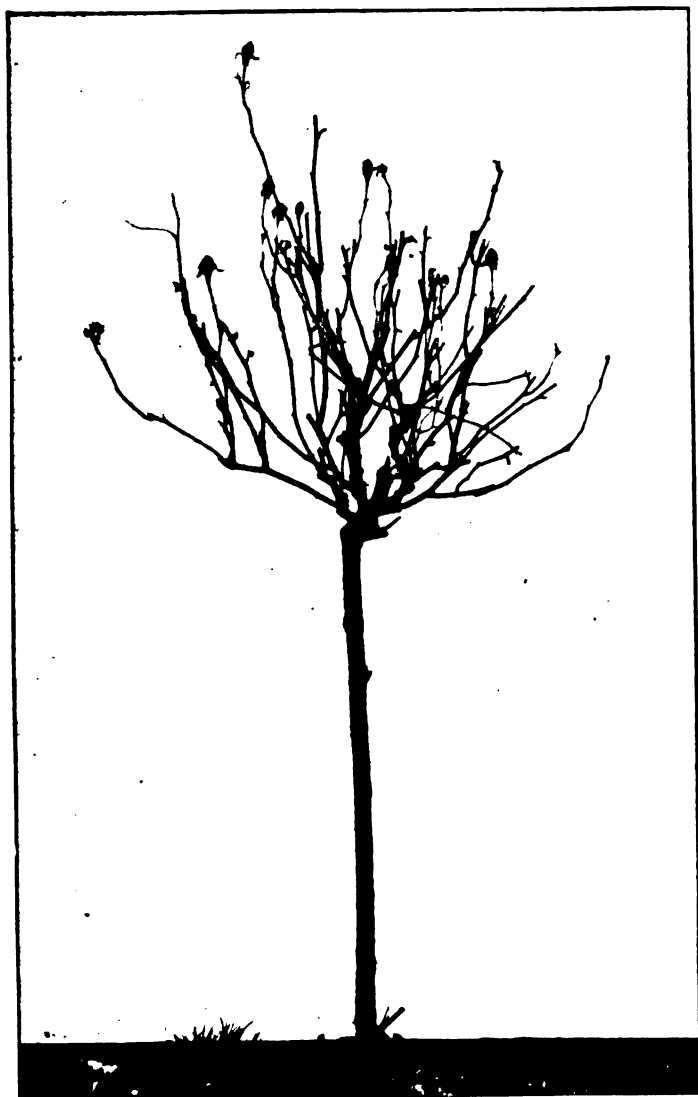


Plate III—Showing growth of the La Rhine on Native Brier.



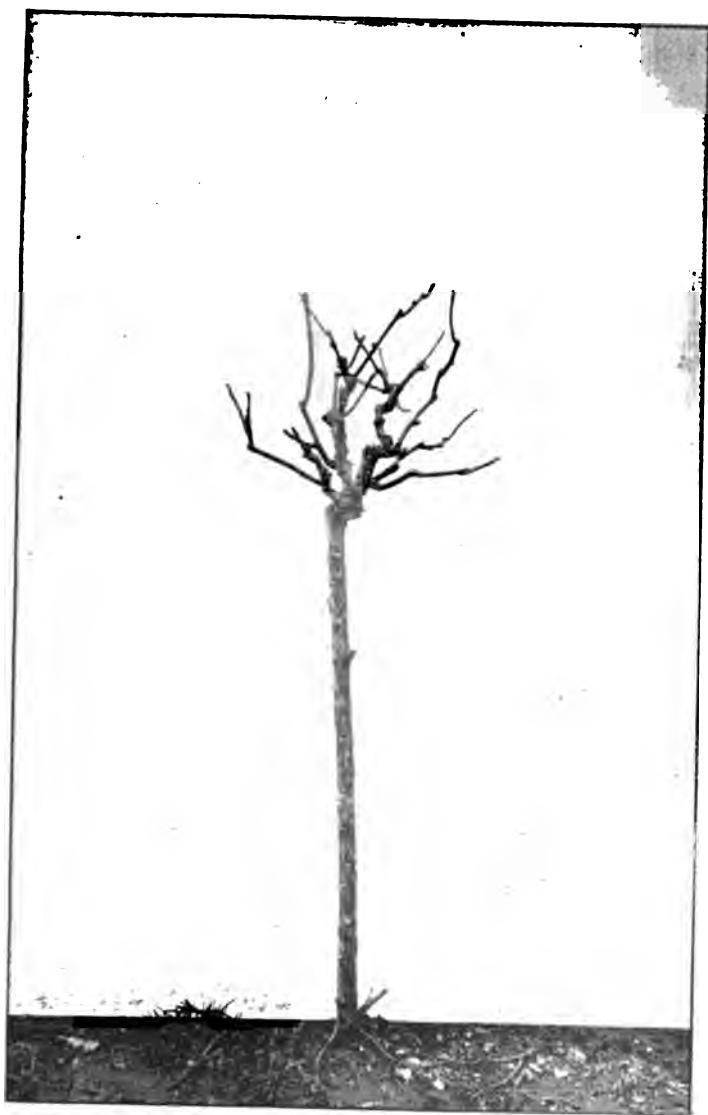


Plate IV—Showing manner of pruning standards.

in such a way that the sun may be entirely shut out from them, permitting it to remain until the middle of March, when the protection may be removed and the plants pruned back, after which the beds should be given a good dressing of well decomposed cow manure. This is much better for the rose, as it is of a cooler nature than horse manure, and the colors of the flower will be brought out much better by it. In speaking of bringing the colors out better, I would say that on gravelly or sandy soil a good coating of clay will be of much benefit.

The rose in general likes a cool soil; that is, if we would have the best of coloring produced. Therefore, in dry, gravelly soils a good coating of strong loam should be given them every third or fourth year. On the other hand, if the soil should be a very heavy clay, such soils would be much benefited by an application of good sharp sand. This will have the tendency to keep the soil porous. Manure should be given the beds and borders every fall. It may be permitted to remain on the surface till spring or forked in. Never use a spade for the purpose, especially among weak growing varieties, as there is danger of damaging the root growth to a great extent; by the use of the digging fork the danger is not so great by any means.

PLANTING.—Varieties that bloom only once a year may be planted in the fall. All roots that have broken in taking up should be cut away. These will form new roots during winter; consequently the plant will make good growth during the following summer. If the soil is wet the planting may be deferred until spring. In planting, the hole should be dug out larger than is required to receive the roots. This done the bottom should be well worked up and good rotted manure worked in with the soil in the bottom of the hole. All is ready for the planting; being careful not to plant too deep, only just so the collar of the plant is below the surface of the soil. If the soil is moderately dry it may be gently pressed down with the foot, being careful to lighten up the surface to the depth of two or three inches around the plant afterwards to prevent baking of the soil.

PRUNING.—The manner and amount of pruning the rose depend on the class to which they belong, and the vigor of the variety. While some recommend fall pruning, I have better results from spring, as there is danger of the plants being damaged by frost, especially the young shoots that would come into growth at a very

early period in the spring thus becoming badly damaged. We find the best results to be had by pruning about the end of February or the first week in March. This method has its advantages as well as disadvantages. Early pruned roses often are damaged by frost as alluded to, and if left too late in spring, so much of the vigor of the plant is taken away by pruning. The happy medium is preferable—that is, not later than the last week in February.

The extent to which the bushes should be pruned depends much on their growth. If a strong grower, plenty of shoots should be removed, but those remaining do not require to be shortened back but little; if pruned too close, wood will be produced instead of flowers. Weakly growing varieties should be pruned back closely leaving only two or three buds.

In cutting out the shoots of any rose, such as are diseased and unmaturing, as well as those that are over-crowded, should be taken out. When pruning, care should be taken not to leave any snags. To overcome the necessity of removing a large number of shoots at the pruning season, and consequently destroying a great deal of the sap, disbudding should be resorted to during the growing season. That is, all over-crowded buds should be rubbed off with the thumb and finger when about an inch long, by this means over-crowding will be obviated, likewise increasing the growth of the other parts of the plant that are left, and will be the means of causing the production of larger and better bloom. In disbudding, the vigor of the plant must be considered just in the same manner as recommended for pruning. If too many buds are removed from the shoots of strong growing varieties, the tendency will be to throw the plant into too strong a growth, then wood will be produced instead of bloom, as in the case of over pruning. With a little practice in this matter, the operator will very soon be able to judge to what extent disbudding may be done.

DISEASE.—The rose is subject to fungous diseases, the worst is the black spot. This may be noticed by the leaves becoming affected with black spots here and there, and if left to take its course will soon cause a premature falling of the leaves. This disease may be greatly reduced by spraying with Bordeaux mixture at the time of pruning. Care should be taken to see that every part of wood is covered with the mixture. It should be done with a very fine nozzle, the same that is used for spraying fruit trees, choosing a dry day for the purpose, so that the mixture may be enabled to dry. When



Plate V—Plant before pruning.



Plate VI—Plant after pruning.

it has once become dry it will take a good deal of rain to remove it. This method has been found to be quite beneficial on the station grounds.

MILDEW.—This disease may be recognized by the leaves of the plants becoming covered with a white powdery substance, at first perhaps on the tips of the young growth, then spreading to different parts of the bush. If taken in time the disease may be kept in check by the free use of powdered sulphur, dusting over the plants and on the ground. This should be done in the early part of the day, choosing a bright sunny day, so that the sun may cause the fumes of the sulphur to be carried up among the foliage. Should a shower of rain occur on the day in which this has been applied it will be needful to repeat it on the first suitable occasion.

GREEN FLY.—This insect may be kept in check by the use of weak tobacco tea. This should be prepared by steeping tobacco stems in boiling water for an hour or two, in the proportion of two ounces to five gallons of water; strain through a piece of gunny sack before using. The next day the plants may be sprayed with clean water from the garden hose.



ROSE CULTURE.

[In response to a request of the Director, the following is contributed by Mrs. Harriet B. Killin, of Portland, who is well known as a successful amateur grower of roses].

LOCATION, SOIL.—To this most beautiful flower should be accorded the best spot in one's garden. Any good, well-drained garden soil, enriched with well-rotted manure is suitable, provided it has sufficient sunlight and is at a proper distance from trees. The soil and climate of Oregon are particularly well adapted to the growing of roses.

PLANTING.—Select strong plants, two years old, budded if possible. Place the bud about two inches below the surface of the soil, pressing the earth firmly about the roots. Annuals should not be planted about the roots of roses. The best time for planting the Hybrid Perpetuals, in Oregon, is October or November, after the rains; for Teas, the spring is preferable.

PRUNING.—Perhaps the most important item in growing roses is the pruning. For the Hybrid Perpetuals, this should be done in December or January. Select the strong, well-matured, young shoots at sufficient distance apart to allow a free circulation of air and cut back to one and a half to two feet, leaving from four to five canes. (See cut No. 1). If, however, the rose is an unusually strong grower, it can be left from three to three and a half feet (Cut No. 2). Even thus it will be found necessary to thin out the young shoots, for if growing too close, they are liable to mildew. The Teas do not require such severe pruning, but it is also important to cut back and remove all old and weak wood.

FERTILIZING.—In the fall, roses should have a liberal top dressing of well-rotted barnyard manure, which should be spaded in in March. After the buds have formed, it will add to the size and beauty of the roses to give them occasionally a weak liquid manure.

SPRAYING.—A good thorough spraying, with Bordeaux mixture, after the winter pruning and again just as growth commences, greatly lessens the trouble with insects and diseases, such as black spot, mildew, etc. For the green aphid which attacks the young



Cut No. 1.

Cut No. 3.



Cut No. 2.

and tender shoots, spraying with Quassia is the most beneficial as well as the least harmful to the plant, using four ounces to one gallon of water, either soaking it over night or boiling for about ten minutes.

DISBUDDING.—For Hybrid Perpetuals, after the buds have formed in the cluster-bearing varieties, remove all but the strong central bud. This gives a beautiful, long-stemmed rose surrounded by handsome foliage.

PROPAGATION.—While this seems a formidable undertaking to the amateur and is a difficult matter with some varieties, yet, with La France, and most of the Teas, it is surprising what can be accomplished with little labor. During October, having selected a protected spot, preferably near a south wall, and after preparing the soil, cut the slips about six inches in length and place them in a slanting position, covering ends not more than one inch. During very severe weather, give a slight protection.

(Cut No. 3—Section of La France hedge). Probably no rose is so universally loved and admired as La France; certainly none has stood the severity of the past winter so well. When its beauty, hardihood and easy propagation are considered, it is surprising that it is not more generally grown for hedges.

With the growing of fine roses, success depends largely on attention to the small details, yet this attention needs to be given so little at a time, to the amateur, it affords merely a healthful and pleasurable recreation.

THOS. M. GATCH, A. M., Ph. D.,
President of the College.

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No. 6, 1890—Chemistry, Zoölogy	Washburn
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Address THOS. M. GATCH,
Director of Experiment Station, Corvallis, Oregon.

[5000.]

Bulletin No. 59.

December, 1899.

CHEMICAL DEPARTMENT,

OREGON AGRICULTURAL EXPERIMENT STATION,

CORVALLIS, OREGON.

Sugar Beet Experiments of 1898

AND

Final Conclusions.

"These data, in connection with those of former years, show that Oregon is one of the most promising localities in the country for successful beet culture."—
H. W. WILEY, Chief Chemist, U. S. Department of Agriculture.

By G. W. Shaw, Chemist.

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E. F. Pernot	<i>Bacteriology.</i>
J. F. Fulton, B. S.	<i>Chemistry.</i>
C. M. McKellips, Ph. C.	<i>Chemistry.</i>



EXTERIOR OF SUGAR BEET FACTORY, LA GRANDE, OREGON.

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No. 48, 1898—Spraying	Cordley
No. 50, 1898—The Fertility of Oregon Soils	Shaw
No. 51, 1898—Marketing Fruit	Craig
No. 52, 1898—Nut Culture	Coote
No. 53, 1898—Sugar Beets	Shaw
No. 54, 1898—Flax, Hemp, Dairy, etc.	French and Kent
No. 55, 1898—Chemistry of Cherries	Shaw
No. 56, 1899—Notes on Prune Dipping and Strength of Concentrated Lyes	Shaw
No. 57, 1899—Brown Rot	Cordley
No. 58, 1899—Rose Culture in Oregon	Coote
No. 59, 1899—Sugar Beet Experiments of 1898 ..	Shaw

Copies will be sent to applicants so long as the supply lasts.

Address THOS. M. GATCH,
Director of Experiment Station, Corvallis, Oregon.

INTRODUCTION.

"A Review of Oregon Sugar Beets" giving the results of investigations (1891-1896), having for their object a determination of the adaptability of Oregon soil, climate and other economic conditions to the production of sugar beets on a commercial scale, was published in March, 1897. In 1898 were published results of continued experiments along the same line.

The present publication sets forth not only the results obtained in the experiments of 1898, but also some observations on the industry now established at La Grande. It presents also the conclusions reached after five years of investigation concerning beet sugar production in Oregon.

Up to 1897 it had been conclusively shown that certain sections of the state possessed all the requisite conditions for beet culture on a commercial scale, and as a result of this work a factory of 350 tons capacity per day was erected and operated successfully last season at La Grande, Union county. The frontispiece shows the exterior of this factory, and on page 10 is given a description of the factory.

EXPERIMENTS IN SUGAR BEET CULTURE--1893.

IN addition to the experiments mentioned in the Introduction it seemed desirable to obtain still further results concerning certain other sections of the state. It was thought best, therefore, to continue the experiments through the season of 1898.

Practically all the seed issued in the experiments of 1898 was furnished by the United States Department of Agriculture and was of the Improved Elite Kleinwanzlebener variety. Concerning this seed the following was said:

"This is one of the best varieties of beets grown for use in the production of sugar. Under favorable conditions of soil and climate this seed should produce from 15 to 16 tons of very rich roots per acre. It is best adapted to soils containing moderate proportions of vegetable matters rather than to black soils."

The U. S. Department of Agriculture also furnished a very limited quantity of five varieties of seed for special test. The varieties were as follows:

- Vilmorin's Improved (Russian grown.)
- Vilmorin's French, very rich.
- Kleinwanzlebener (grown by Vilmorin.)
- Schreiber's Elite.
- Pitzschke's Elite.
- Zeringen (grown by Strandes.)

Concerning this seed the following was stated in the accompanying letter:

"The Russian seed was grown for the firm of Vilmorin-Andrieux & Cie. This seed is from the crop of 1896; therefore it is probably of low vitality. I advise planting this seed at the rate of 36 lbs. per acre in order to insure a good stand.

The Zeringen seed was grown by Ad. Strandes, Rittergut, Zeringen, bei Cöthen, Anhalt, Germany, who requests that a copy of the station report of the analyses of beets from this seed be sent to him when published.

It is my desire to obtain a few beets from each lot of seed for use in seed production. At the proper time please send me a few of the beets, according to shipping directions that I will give you, transportation at the expense of the Department."



PLATE I. TYPICAL SUGAR BEET FIELD, LA GRANDE, OREGON.

Early in the spring notices were sent out, by circular letters and through the papers published in the localities where it seemed desirable to conduct further experiments, offering to furnish seed to such parties as desired to enter upon this co-operative work. As we had sufficient seed, no one who applied for it was refused, even though the locality was not within the area selected for special work.

The character of cultivation was the same as that of preceding seasons, details of which have already appeared in former publications.

In response to requests, seed was sent to 170 farmers who agreed to cultivate experimental plats and forward samples for analysis. Of this number there were 55 who reported entire failure from one cause and another, and 27 who failed to report at all, leaving 52 per cent of those who engaged to do the work from whom results were finally obtained.

For consideration of results it has been the custom in former publications to divide the state into three divisions, Eastern, Western and Southern Oregon on account of the wide difference in climatic and soil conditions, and the same plan will be followed in this case.

Details and individual analyses are omitted from this publication, averages only being given.

The beets were harvested in accordance with the following directions which were furnished by the United States Dep't of Agriculture:

THE STATE AGRICULTURAL EXPERIMENT STATION.

DIRECTIONS FOR SECURING SAMPLES OF SUGAR BEETS FOR ANALYSIS.

Prepared by H. W. WILEY, Chief of Division of Chemistry, U. S. Department of Agriculture.

When the beets appear to be mature (September 15 to November 15, according to latitude and time of planting), and *before any second growth can take place*, select an average row (or rows), and gather every plant along a distance which would vary as follows, according to the width between the rows :

From rows 16 inches apart, length 75 feet.

"	"	18	"	"	"	66	"
"	"	20	"	"	"	59	"
"	"	22	"	"	"	54	and four-fifths feet.
"	"	24	"	"	"	50	"
"	"	28	"	"	"	42	"

The beets grown in a row, of the length above mentioned, are counted. The tops are removed, leaving about an inch of the stems, the beets carefully washed free from all dirt and wiped. Where the row is not long enough to meet the conditions, take enough from the adjacent row or rows to make up the required length. Rows of average excellence must be selected ; avoid the best or poorest. Throw the beets promiscuously in a pile and then select the largest or smallest

From all of the rest of the beets, save these two, the necks are removed with a sharp knife at the point indicated by the dotted line in the figure. The beets, including the two saved as a sample, are then weighed.

The number of beets harvested multiplied by 435.6 gives the total number per acre. The total weight of beets harvested multiplied by 435.6 gives the yield per acre.

Wrap the two sample beets carefully in soft paper, and write your name legibly thereon. The beets must be perfectly dry. Fill out the descriptive blank, inclose it in the envelope, and sew it up in a cotton bag with the beets, attach the inclosed shipping tag, and send the package by mail.

No beets will be analyzed by the Station which are not packed as described above and properly identified. In all cases a copy of the descriptive blank supplied by the Station must accompany each sample.

Miscellaneous analyses of samples without accurate description are of no value.

Blanks are sent to each one for two sets of samples. From two to four weeks should elapse between the times of sending the two sets of samples.

If additional analyses are desired other blanks will be sent on application, but not more than four analyses can be made for any one person, except in special cases.

A model, showing how blanks should be filled out, is inclosed.

Samples were forwarded by mail, franking tags for this purpose being sent to the grower, and were accompanied by the following report, filled out by the grower:



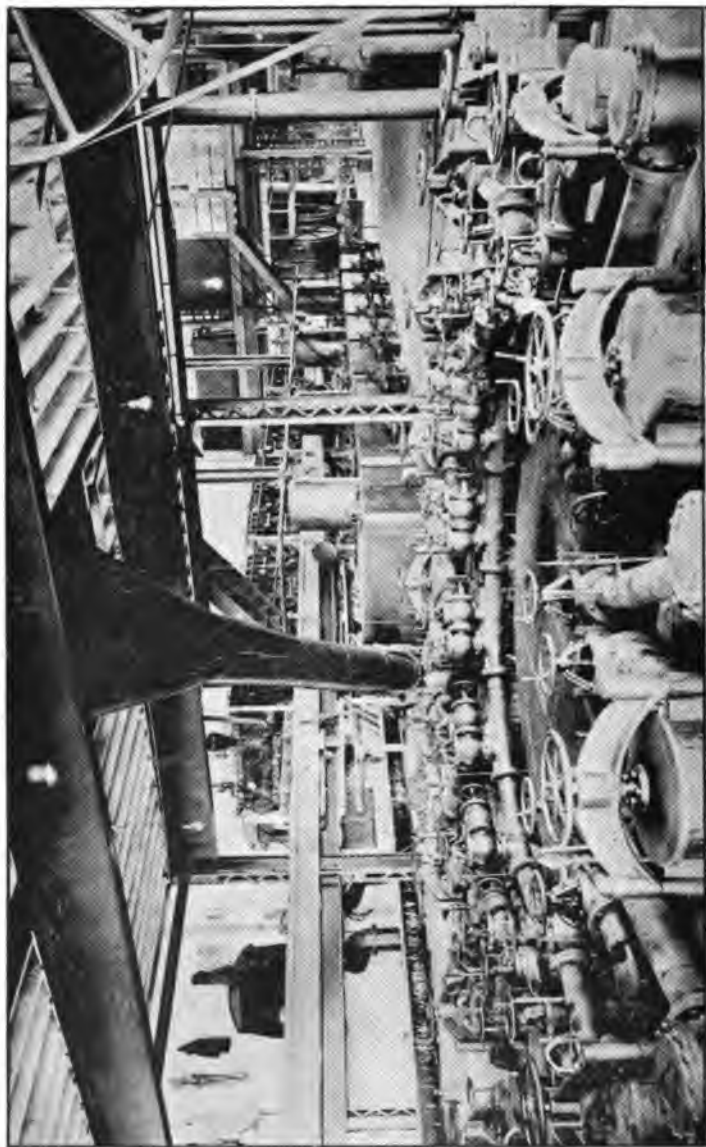


PLATE II. INTERIOR OF BEET SUGAR FACTORY, LA GRANDE, OREGON.

Experiments in Eastern Oregon.

UNION COUNTY.

No extensive experiments in the growth of beets were conducted in this county inasmuch as previous results had conclusively demonstrated the Grand Ronde valley to be particularly well adapted to the production of beets for sugar, as a result of which there had already been erected the first sugar factory in the state.

In this connection a few words will not be out of place relative to the industry in that locality. The factory, an exterior view of which is shown in the frontispiece, was erected in the summer of 1898 at a cost of about \$400,000. It is a stable structure of brick and steel, the main building being 288 feet long and 66 feet wide. The sugar storehouse adjoining is 160x66 feet. The sheds for receiving and storing beets are four in number, each being 500x25 feet. Silos for storing beet pulp to be used as cattle food aggregate 500 by 100 feet. Six furnaces and a bank of engines furnishing 1200 horsepower occupy a separate brick and steel structure 150x40 feet. These several buildings with their approaches, side tracks, etc., occupy 80 acres of land. The capacity of the factory is 350 tons of beets per 24 hours, which is equivalent to 35 tons of refined sugar. A test of the capacity of this factory, however, made last season showed that it surpassed this by considerable as it actually handled 450 tons of beets in the 24 hours. In its operation it requires 100 skilled men and uses about 8000 cords of wood and 2000 tons of lime during the season.

It is to be regretted that the first season of this new industry was confronted by so many unfavorable conditions. Many of the experiences of the first year were incident to the starting of the industry and would have occurred anywhere in the United States, hence they are not to be looked upon as any drawback to final success.

The writer in company with Mr. Alfred Holman of the Oregonian staff made a tour of the factory and some of the fields soon after the opening of the campaign, and the conditions which brought about the apparently poor results to the farmers were so aptly discussed by Mr. Holman in a series of articles published in the Oregonian that I take the liberty of quoting:

"The first mishap was in connection with the time of planting. There was serious miscalculation as to time, which carried the seeding season, which should have ended in May, into the early days of July. The planting too was

upon stubble and in many cases upon foul land, where no plowing had ever gone deeper than four inches. Under these conditions weeds at once took the soil and owing to their extraordinary thrift and to the tardiness of inexperienced labor the work of weeding and the subsequent work of thinning were carried into midsummer or long past the usual and favorable time. Even under all these disadvantages there would have been a fair crop, for everything promised well till August, when there came the extraordinary spell of hot weather which did so much harm to all crops east of the mountains. It found the beet fields freshly loosened from the operations of the weeders and thinners and in the worst possible condition to withstand a season of drought and heat. For a period of 20 days the temperature held from 90 to 105 degrees and before the hot spell was half through it became clear that the jig was up so far as the beet crop was concerned. Upon the return of cooler weather the fields revived somewhat but the injury had been too serious for complete recovery."

To the above described difficulties there may also be added that of spring plowing instead of fall plowing. This became necessary in the first season of the industry because the contract for the building of the factory was not made till very late in the season preceeding, and contracts were not signed by farmers for the growing of beets till the winter. These contracts when they were signed were in the main for a large acreage. Beets should be grown in small areas by a large number of farmers instead of in large areas by a small number of farmers as is now the case.

The people of LaGrande, and indeed the entire state, have much to congratulate themselves for as the industry is one of the most important in the northwest and is bound to be successful. The percentages obtained the first season were exceptionally high both in sugar content and purity. The factory books show the percentage of sugar to have been 15.6 for the entire crop and the purity 84.6 which is, so far as I am able to ascertain higher than any first year results obtained elsewhere. The present season the tonnage was more nearly normal, although not so high in general as I think it will finally be for that region; the cultivation cost less than in the first season, because the farmers understood the habits of the beet better; and the sugar content and purity were both excellent. The average results of beets delivered to the factory to October 25 were 15 percent. sugar and 82 percent. purity.

A small number of beets from Union county were analyzed during the season of 1898. The five varieties previously mentioned on page 5 as having been sent to the Station by the U. S. Department of Agriculture were placed in the hands of Mr. L. Oldenburg of

LaGrande. Samples of these were received at the Station laboratory for analysis at stated intervals with the following results:

Lab. No.	Date.	VARIETY.	No. of beets in sample.	Av. weight of beets.	Sugar in juice	Purity.
1402	Sept. 7, '98	1. Vilmorin's Improved (Russian grown).....	3	251		
1403	"	2. Kleinwanzlebener (grown by Vilmorin).....	3	238	16.9	88
1404	"	3. Zeringen (grown by Strandes).....	3	292	19.8	89
1405	"	4. Vilmorin's French, very rich.....	3	351	17.1	87
1406	"	5. Pitzschke's Elite.....	3	266		
1407	"	6. Original Kleinwanzlebener (factory seed).....	3	402	19.3	87
1408	"	7. Schreiber's Elite.....	3	402	19.1	87
Average.....			21	315	18.4	88
1421	Sept. 14	1.	3	512	15.1	83
1419	"	2.	3	243	16.0	86
1417	"	3.	3	502	14.0	84
1423	"	4.	3	326	15.1	85
2418	"	5.	3	432	15.2	86
1422	"	6.	3	368	15.0	77
1420	"	7.	3	215	16.7	88
Average.....			21	371	15.3	83
1433	Sept. 20	1.	3	340	16.6	90
1434	"	2.	3	352	16.5	83
1432	"	3.	3	320	15.6	80
1435	"	4.	3	473	15.0	83
1431	"	5.	3	432	16.5	87
1436	"	6.	3	568	18.7	86
1430	"	7.	3	326	16.8	85
Average.....			21	356	16.5	85
1615	Sept. 30	1.	3	442	15.5	84
1609	"	2.	3	287	17.7	87
1612	"	3.	3	252	18.0	90
1613	"	4.	3	332	16.2	84
1614	"	5.	3	308	16.2	81
1610	"	6.	3	497	19.6	82
1611	"	7.	3	267	17.5	87
Average.....			21	371	17.3	85

The following table shows the results of analyses expressed by varieties. These varieties were from the seed furnished for special trial by the U. S. Department of Agriculture except where indicated, and all are comparable since grown under the same conditions of soil, climate and cultivation. The seed furnished by the factory made considerably the best showing for the season's work:

RESULTS OF VARIETY TESTS.

VARIETY.	Total number of beets in sample.	Average weight.	Sugar in Juice.	Purity.
Vilmorin Improved (Russian grown)	9	431	15.7	86
Klein Wanzlebener (grown by Vilmorin)	12	275	16.7	86
Zeringen (grown by Strandes)	12	353	16.8	86
Vilmorin French, very rich	12	370	15.8	85
Pitzschke's Elite	9	359	15.9	84
Seed from Factory (Original Kleinwanzlebener)	12	459	18.1	86
Schreiber's Elite	12	303	17.5	87

Of the varieties experimented with in this county none have done so well as the original Klein Wanzlebener. I learn, however, that a variety of which we have not made a sufficient number of analyses to base an opinion, Knauer's Mangold, has also been satisfactorily grown there on a commercial scale.

An examination of the table shows that the beets made no improvement after September 7, except in a slight growth which was more than counterbalanced by loss occurring both in sugar content and purity, for the beets showed a loss of one percent. in sugar and three percent. in purity. The moisture and cooler weather of September immediately showed its effects on the beets by lessening the sugar content and purity, but increasing the weight. This loss of sugar content was never regained. I very much doubt whether it is best to delay beet harvest later than the first week in September provided the seed was planted in proper time in the spring. This is particularly true provided they have to withstand a long dry spell as in the season of 1898, which practically matures the beets before they have reached their full growth. There might, perhaps, be years when such delay would be best, but in my opinion the chances of loss more than counterbalance those of gain in weight.

It was the intention to forward samples of these beets to Washington, D. C., to be used in experiments in seed production but sampling and shipping directions were not received from the Department of Agriculture till it was too late to secure the samples.

Results of other analyses made from this county are stated below:

GROWER.	POSTOFFICE.	Av.	Av.	Solids	Purity		
		weight.	Sugar.				
		Grams	In juice	In beet			
1416	Turner Oliver	La Grande	563	14.5	13.8	19.1	75.9
1442	H. Cordes	"	284	17.6	16.7	20.7	85.0
1443	"	"	340	16.2	15.2	18.6	87.0
1447	Turner Oliver	"	553	10.4	9.9	15.0	69.7
1448	"	"	358	11.7	11.0	15.9	76.4
1449	"	"	292	12.9	12.3	15.7	82.1
1600	"	"	401	15.6	14.8	19.8	78.8
1601	"	"	840	14.0	13.3	17.2	81.4
1602	"	"	497	14.5	13.8	20.2	71.7
1607	W. G. Hunter	"	278	20.5	19.4	23.5	87.0
1608	H. Cordes	"	363	18.4	17.5	21.8	84.4
1648	Turner Oliver	"	438	16.8	16.0	18.8	89.8
1649	"	"	475	13.7	13.0	16.0	85.5
1650	"	"	475	13.7	13.0	16.0	85.5
1680	H. J. Baker	Pine	400	16.0	15.2	17.7	90.4
1699	"	"	400	17.3	16.4	19.2	89.3
1728	J. B. Weaver	Union	275	18.3	17.3	21.0	86.9
1729	"	"	406	21.3	20.2	23.6	90.0
Average			446	15.8	14.9	18.3	83.2

Reviewing the results expressed above, the analyses ranged from 10.4 per cent sugar in the juice, purity 69.7 per cent, in a beet weighing 553 grams (19.4 oz.) to a maximum of 21.3 per cent sugar in the juice, purity 90, in a beet weighting 406 grams (12.2 oz.) The average for the county was sugar in juice 15.8 per cent, purity 83.2, weight 446 grams (13.4 oz.).

EFFECT ON THE SOIL.

There is probably no place in this country where the natural fertility of the soil will surpass that of the Grande Ronde valley. One dislikes to take positive issue with a man of so broad experience as the gentlemanly superintendent of the factory for 1898, but I can not refrain from saying that he gave the farmers entirely wrong advice as to the advisability of planting beets successively on the same soil. It has been so conclusively proven as to be beyond question that beets are a very exhausting crop unless the greatest care is taken to conserve the fertility of the soil. It is true that the sugar beet impoverishes the soil but little if care is taken to plow the tops under in the field and return the pulp in the shape of stable manure. Under these conditions there is practically no loss of fertility, for sugar contains no element of fertility—it may be considered condensed sunshine. If, however, the entire crop is removed from the field there is a very great loss of fertility. It is a serious mistake to underestimate the benefit of beet tops as a fertilizer. They are of great value and every farmer who restores them to the soil realizes

a double profit in the chemical and physical improvement of his land.

It is doubtless true that several crops of beets may be taken from the same soil before ill effects will be perceived, yet such effects are sure to follow. This will be the more noticeable if the pulp is not fed and returned to the land as manure. If the tops are not returned to the land the rate of exhaustion will be about four times as great as if they are turned under. Can the land stand the drain is a pertinent question for each farmer. Nor is it the best practice to feed the tops, for say what we will, it is very likely that the manure thus produced will not go back to the place which most needs it.

It is certainly bad policy to produce beets on the same soil successively for many years. The best results may be obtained by rotation with cereals and occasionally a leguminous crop as a nitrogen gatherer, by which practice both crops will be much benefited.

BEET PULP AS A CATTLE FOOD.

There is one side of the beet sugar industry which observation and inquiry show is not receiving the attention which it deserves in the Grande Ronde valley. I refer to the feeding of beet pulp to cattle and sheep. Located as the valley is in the midst of the best stock regions of the Pacific coast, in a region where such excellent crops of alfalfa can be grown, there seems to be no reasonable excuse for neglecting this side of the industry, both for fattening stock and the manufacture of dairy products. The fullest fruits of the industry will never be realized till attention is given to this phase of the subject. Nothing has been more conclusively demonstrated than that beet pulp is a most excellent cattle, sheep and hog food when properly balanced with nitrogenous material, as alfalfa, clover or grain. While the leaves and tops are good food, pulp is much better. A chemical analysis of the pulp produced at La Grande shows the following composition:

Water-----	89.01.	Dry Matter-----	10.99.
		Fat-----	.58.
		Fibre-----	2.40.
		Protein-----	.88.
		Ash-----	.70.
		Carbohydrates ..	6.43.
		Total-----	10.99.

No analysis was made of the siloed pulp but there is not a very great change in the chemical composition as will be shown by the following analysis given in the "Revue Universelle des Progres de la Fabrication du Sucre," 1, 428:

	Maercker.		Kuhn.	
	Before Ensilage.	After Ensilage.	Before Ensilage.	After Ensilage.
Water	89.77	88.52	88.9	87.6
Dry Matter.....	10.23	11.48	11.1	12.5
Ash.....	.58	1.09	.9	.9
Fat.....	.05	.11	.1	.1
Crude Fibre.....	2.39	2.80	2.5	3.0
Crude Protein.....	.89	1.07	.9	1.2
Nitrogen-free Extract	6.82	6.41	6.7	7.3

Beet pulp is not a balanced ration and the best results can not be expected from feeding it alone, though it is a healthful and nutritious food. Its chief components are the carbohydrates and proteids. It is essentially a fattening food. Experience has shown that it is relished by dairy cattle and produces an excellent flow of milk when balanced with nitrogenous foods. The pulp is valuable not only as cattle food but also as food for hogs and sheep. In Utah it is largely used as hog food.

It is one of the cheapest foods that farmers can use for it can be purchased at a very nominal figure. Each team as it delivers its load of beets should take home a load of beet pulp. This pulp should be placed in a silo where it is much more easily kept than any other silage material. It is very heavy and sinks down to a very solid, cheesy mass. When properly preserved it does not tend to ferment and can be kept a very long time. Mr. Allen of the Standard Cattle Company is authority for the statement that even in very cold weather, a large pile can be left out of doors and while a crust of 8 or 10 inches will freeze on the outside the inside will remain in good condition.

MALHEUR COUNTY.

In Bulletin 53 it was stated that a few analyses had been made of beets grown at Ontario, and that the sugar content and purity had been most excellent. Seed was distributed in this locality in 1898 and arrangements made with Mr. T. T. Danielson, of Arcadia, to grow an experimental plat of beets and to forward samples regularly for analysis.

Twelve samples were analyzed during the season with the following results:

Beets showing 14-15 per cent sugar in juice.....	1
“ “ 15-16 “ “ “	3
“ “ 16-17 “ “ “	2
“ “ 17-18 “ “ “	2
“ “ 18-20 “ “ “	4

The average results obtained other years as well as 1898-1899 are:

TIME OF ANALYSIS.	Number of Analyses	Av. weight, oz.	Av. Sugar in Juice.	Av. Purity.
1891-1892.....	1		20.20	84.9
1897-1898 by Station.....	12	18	17.70	90.8
1897-1898 by Utah Sugar Company.....	15	20	16.10	84.1
1898-1899 by Station.....	12	17	16.9	87.1

These results certainly show that this section of the state is capable of producing very high grade beets. The tonnage on a plat of 5 acres this year was 50, showing that nothing need be feared in the matter of yield. Again the conditions of growth in this region are much the same as in Utah, in that all operations are conducted under the irrigation system, which practically insures a crop when the system is properly understood.

There is plenty of land suitable for beet culture in this region, and were it not for the fact of a sparse population it would be a most excellent point for the location of a factory. Unless a larger population can be brought beet culture would be out of the question. If this difficulty could be overcome there would be no better place in the state for a factory. There is abundance of water and land, it is near excellent lime curries, and fuel can be readily obtained.

OTHER LOCALITIES.

The following analyses were made of beets from other localities in the eastern part of the state:

	GROWER.	POSTOFFICE.	Average Weight.		Sugar.		Solids not Sugar.	Total Solids.	Date of Planting.	Date of Harvest.
			Grams.	Ounces.	In Juice.	In Beet.				
1438	Shinn, R. A.....	Joseph	495		18.8	17.8	85.0	3.4	22.2	May 2 Sept. 10
1709	Maxwell, J. S.....	Enterprise	320		17.6	16.7	82.5	3.7	21.3	May 15 Oct. 7
1710	McAllister, J. W.....	Enterprise	403		11.1	10.5	70.2	4.7	15.8	May 15 Oct. 20
1764	Maxwell, J. S.....	Enterprise	935		18.2	17.2	83.8	3.5	21.7	May 15 Nov. 3
Average.....			538		16.4	15.5	80.4	3.8	20.2	

Western Oregon.

Many beets were also analyzed from western Oregon, mainly from the Willamette valley, the results of which are printed below. These are classified by counties and show the average for each county.

NAME OF COUNTY.	No. of Analyses.	Average Weight in Grams.	Sugar in Juice.	Purity.
Benton	3	691	13.0	82.9
Clackamas	9	390	17.0	86.8
Coos	1	545	13.8	85.7
Douglas	15	752	14.8	86.2
Lane	12	474	14.9	86.1
Lincoln	7	604	14.6	86.9
Linn	21	554	14.5	88.3
Marion	6	703	14.0	82.9
Multnomah	10	556	14.8	86.6
Polk	2	595	11.8	84.3
Tillamook	3	377	17.3	90.6
Washington	4	413	15.3	87.6
Yamhill	12	564	14.3	82.2

Of the 105 analyses reported, western Oregon, 97 show above 12 per cent sugar in the juice; 74 above 14 per cent, and 35 above 16 per cent. The average of all analyses for the season for western Oregon was 14.8 per cent sugar in juice, purity 85, weight of beets 425 grams (14.87 oz.) Results obtained other years are:

YEAR.	No. of Analyses.	Sugar in Juice.	Purity.
Season of 1891	81	13.7	77.9
Season of 1892	41	14.7	81.7
Season of 1897	115	15.1	85.6
Season of 1898	105	14.8	85.0

This shows that western Oregon can certainly grow beets satisfactory both as to sugar content and purity. Other things than the ability to grow good beets, however, have to be taken into consideration in locating a sugar factory. There are certain other factors which are of as great importance as the ability to produce beets. For a full discussion of these the reader is referred to Bulletins 44 and 53 of this Station.

The Willamette valley is much handicapped by having a soil which is generally too clay-like for beet production for sugar purposes. Rains also are very likely to occur just about the time beets mature thus rendering a successful harvest very uncertain. Beets grown in the soils of Willamette valley have a great tendency to throw out many root hairs and branching roots even with good cultivation. This, in addition to the sticky nature of the soil, would render it almost impossible to properly wash beets delivered at the factory. These facts taken together with that of lack of a cheap lime supply enforce the conviction on one that it is not wise to advocate the establishing of sugar factories in this portion of the state.

Southern Oregon.

JACKSON COUNTY.

As a result of experiments and data secured in 1898 I stated in Bulletin 53 that I believed Jackson county possessed all the requirements for a sugar factory. To gain more extended data many analyses of beets grown in that country were made in 1898. These results are summarized as follows:

Forty-six samples were analyzed from the county. The results ranged from 10.9 per cent sugar in the juice, purity 69.4 per cent to 20.2 per cent sugar in juice purity 86. The weight of beets ranged from 9.5 oz. to 54 oz. The beet giving the lowest results, however, could not be considered mature. Of the 46 analyses made 40 showed over 12 per cent sugar in juice, 23 showed over 15 per cent, 21 showed over 16 per cent, and 14 over 17 per cent. The average for the county was 15.8 per cent sugar in juice, purity 83.8, weight 547 grams (19.1 oz.).

The average results obtained in this county in other years are:

YEAR.	No. of Samples.	Average weight. Grams.	Sugar in Juice.	Purity.
Results of 1891.....	3	275	18.9	80.99
Results of 1892.....	1	783	15.0	84.74
Results of 1897.....	60	437	15.4	81.00
Results of 1898.....	46	546	15.8	83.80

The time of planting ranged from April 1st to June 1st. The latter time is considered altogether too late for this section of the state. The time of harvest extended from August 28th to November 4th. The earliest beets and the latest beets came from the same field and were purposely thus harvested to note the effect of late harvest on the beets in this section.

EFFECT OF LATE HARVEST.

	Average of 16 beets harvested before October 1.	Average of 12 beets harvested after October 10
Weight in grams	487	550
Sugar in juice	18.0	14.7
Purity	84.9	84.6

The above is a most excellent illustration of the deterioration of beets, after becoming once mature, by the starting of a second growth.

INFLUENCE OF TIME OF PLANTING.

Of the analyses made of beets from Jackson county the reports show as follows:

	Planted before May 1. Av. of 48 Analyses.	Planted after May 1. Av. of 14 Analyses.
Average weight of beets	504	566
Per cent sugar in juice	15.19	16.58
Purity	82.1	83.4

From the above it appears that there is plenty of time in this county for beets to mature if planted by May 1st. I believe the yield, however, would be better by earlier planting. The reports sent in by the growers are too unreliable and irregular to base definite conclusions upon so far as this factor is concerned. It requires about 100 to 110 days for beets to mature and if in the ground by May 1st they would be ready to harvest by September 1st and are not likely to be injured by rain if they should be delivered at once to a factory.

When these results are considered in connection with the fact that all the conditions for maintaining a factory exist in the immediate vicinity, as shown in Bulletin 53, I feel confident that there is

no better location for a factory to be found than exists in Jackson county. The people of that section of the state should recognize the importance of this great industry and take steps towards securing the location of a sugar factory in their midst.

CONCLUSIONS.

These results complete a series of experiments to determine the adaptability of the state in its several sections to the sugar beet. The conclusions reached after a most careful investigation not only of the ability of the various sections to produce beets of a high grade, but also of the other economic conditions essential for the industry are as follows:

First. That three sections of the state are exceptionally well adapted to the industry, viz., Union county in the vicinity of La Grande; Malheur county in the vicinity of Ontario and Arcadia; Jackson county in the vicinity of Medford, possessing as it does a large area capable of producing a very large supply of beets. Water, fuel and limestone are easily and cheaply obtainable in each locality.

Second. That the most serious obstacle in any of these localities is the limited number of people available for field help at short notice, especially would this be true in Malheur county.

Third. That western Oregon is not well adapted to the industry on account of the early fall rains and a soil which is very heavy and sticky, and tenacious to the beet when wet, and it also lacks a cheap lime supply.

Fourth. Beet growing in Malheur county would have to be under a system of irrigation similar to that in Utah.

Fifth. If beets are planted by the middle of April either in eastern or southern Oregon nothing is gained by delaying harvest later than the first week in September.

Sixth. That the Original Klein Wanzlebener and the Elite Klein Wanzlebener have proven themselves well adapted to the conditions in the Grande Ronde valley, and both have given good results in Jackson county. The former has given the better results in the latter place. Each has given better results in each place than the Vilmorin.

Seventh. That in eastern Oregon beets may be left in the ground quite late without serious loss from second growth.

Eighth. That beets for sugar production should not be planted on alkali soils.

Ninth. That beets may be allowed to grow much larger here than in Germany and still hold an excellent per cent of sugar.

Tenth. That the hill lands of Jackson county are not well adapted to the industry.

Eleventh. That the establishment of a sugar factory makes possible a most excellent opportunity for a high development of the dairy industry. This is of no mean consequence when it is remembered that all three of the localities which present favorable conditions for the industry produce immense quantities of alfalfa, and yet ship in dairy products in large amounts. Why not produce them at home and supply the neighboring sections?

Twelfth. That the establishment of a sugar factory means also the development of a large fuel and lime industry.

ACKNOWLEDGEMENTS.

In closing this series of experiments I desire to thank those who co-operated in the work by growing beets and reporting results. It is only by such co-operation between the Station and the farmer that the best results can be obtained in such an investigation, and a satisfactory answer obtained to the question at stake. I desire also to extend thanks to Mr. C. M. McKellips, assistant in this department, for the faithfulness with which he attended to the routine work of analysis in the season of 1898.

ERRATA.

Through an oversight the last three lines on page 8 were left in the copy when they should have been expunged.



Bulletin No. 60.

January, 1900.

OREGON AGRICULTURAL EXPERIMENT STATION,

CORVALLIS, OREGON.

APPLE TREE ANTHRACNOSE

A New Fungous Disease.

A. B. Cordley.

The Bulletins of this Station are sent Free to all Residents of
Oregon who request them.

AGRICULTURAL COLLEGE PRINTING OFFICE,
GEO. B. KEADY, PRINTER.
1900.

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E. R. Lake, M. S.	<i>Horticulturist and Botanist.</i>

Other Members of Staff.

George Coote	<i>Florist.</i>
F. L. Kent, B. S.	<i>Dairying.</i>
E. F. Pernot	<i>Bacteriology.</i>
J. F. Ralton, B. S.	<i>Chemistry.</i>
C. M. McKellips, Ph. C.	<i>Chemistry.</i>

SOME PRELIMINARY NOTES

ON

APPLE TREE ANTHRACNOSE.

These few notes are issued to call the attention of growers to a serious disease of apple trees; to indicate the nature of the disease and how it is propagated; and to suggest methods for its control.

The disease is new only in the sense that its cause has never before been described. For several years past the apple orchards of the Pacific Northwest, including western Oregon, Washington and British Columbia have suffered more or less seriously from the attacks of this disease which has been known locally as "canker," "dead spot" or "black spot." In fact the ravages of the disease have been so serious the past season that persons prominent in horticultural affairs have expressed the conviction that the apple growing industry of the above mentioned regions is threatened with destruction. While not in any sense agreeing with this pessimistic view, we realize that the disease is a serious one and several months ago undertook the problem of discovering its cause, and, if possible, a satisfactory remedy for it. As a result of our work up to the present time, the first problem has been solved and we believe we can offer a reasonably satisfactory solution of the second.

AN UNDESCRIBED DISEASE.

Although of considerable importance, the disease seems to have been almost entirely overlooked and nothing of importance concerning its nature has been published. Some months ago Mr. Paddock of the New York Experiment Station at Geneva, discovered that a fungus which causes the well known "black rot" of apples and quinces, is also the cause of a disease of apple bark which he named "canker." At the time we were in hopes that Mr. Paddock's discoveries would explain the cause of our somewhat similar western disease but only a cursory examination was needed to show that

this is not the case; and recently I have had, with Mr. Paddock, the privilege of comparing the two diseases with the result that we were both convinced that they are entirely distinct. Further study also convinced me that the disease is a new one and that it is caused by an undescribed species of fungus for which I have proposed the name *Glæsporium malicorticis*.

COMMON NAME OF THE DISEASE.

As stated above the disease has been known locally as "canker," "dead spot" and "black spot." Ordinarily it is best to accept a common name when once established in any locality, but in this particular instance we believe that confusion in the designation of the disease in future can best be prevented by adopting for it an entirely new name. The term "canker" is most commonly used in European works on plant diseases to designate injuries to the bark which are caused by various species of *Nectria*. In the eastern United States it has been applied, by Mr. Paddock, to a disease of apple bark which is caused by a *Sphaeropsis*. To apply the same name to a disease which is caused by a fungus entirely different from either of these would only lead to confusion. "Dead spot" and "black spot," the two other names which are sometimes used, are applied not only to the disease under consideration but also to diseased areas which are due to various other agencies, such as sunscald, the pear blight bacillus, etc. In view of these facts and in order to avoid confusion, we shall propose for the disease the somewhat unwieldy name of APPLE TREE ANTHRACNOSE. Although somewhat cumbersome, the name seems appropriate from the fact that the fungus which causes it, *Glæsporium malicorticis*, is closely related to numerous other fungi of economic importance which have quite generally been designated as anthracnoses.

NATURE OF THE INJURY.

Apple tree anthracnose attacks principally the smaller branches—those under two or three inches in diameter—although it also occurs upon the larger ones and on the trunks of young trees. It appears first in fall, soon after the autumn rains begin, as small, irregular, sometimes slightly depressed, brown areas of the bark. During the fall and winter months it spreads but slowly; but with the advent of warmer weather in spring, growth takes place rapidly until,

under favorable conditions, the disease may invade an area several inches in diameter. Such areas under observation at Corvallis the past season ceased to enlarge late in May, and early in June the first evidence of spore formation was noted. At that time the diseased areas were dark brown in color, markedly depressed, and in most instances limited by ragged, irregular fissures which separated the dead from the surrounding living tissues. These dead spots vary in size from those not more than one-half inch in diameter to extensive areas two or three inches wide by six or eight inches long. Occasionally a single area completely girdles a branch, thus killing at once its distal portion; but more commonly only a dead spot occurs from which in the course of a few months the bark sloughs off, leaving an ugly wound which requires several years to heal. When these wounds are at all numerous the branches are exceedingly rough and disfigured and are moreover greatly weakened.

CAUSE OF THE DISEASE.

Apple tree anthracnose is caused by a fungus which belongs to the genus *Gloeosporium*. It is therefore one of the imperfect fungi—so-called simply because the perfect form, if it has one, is not known. If a recently anthracnosed spot be examined carefully, it will be seen to be covered by minute projections. These are known as the acervuli and they contain the spores of the fungus. At Corvallis the past season they began to appear early in June. At first they were noted as small conical elevations of the epidermis which were scattered irregularly over the diseased area. By the end of June these elevations had increased considerably in size and in a few instances the overlying epidermis had been ruptured so as to expose to view the cream colored mass of spores, which, however, soon became dark colored. During July, August and September these acervuli became more and more abundant and by the beginning of October a very large proportion of them had burst open for the purpose of discharging their spores. Spores which were collected late in June were immature and could not be induced to germinate. Others which were gathered in July were also mostly immature, but in October I obtained an abundant supply of mature spores which germinated very readily. The mass of spores in each acervulus can be easily seen with the unaided eye but the individual spores are so small that they can only be seen by the aid of

a good microscope. They average about 6×24 microns and are single celled, hyaline or with a greenish tinge, elliptical, curved or geniculate and coarsely granular. Sections through a mature acervulus show, under the microscope, a sub-epidermal stroma from which arise comparatively long, closely compacted basidia, on the ends of which the spores are born. It is the growth of this underlying mass that finally ruptures the epidermis over it and thus sets free the spores.

HOW THE FUNGUS WORKS.

As stated above, the spores mature, and the acervuli burst open to set them free in late summer and early fall. Thus exposed, the spores are doubtless distributed by the rains and winds and possibly to some extent by birds, insects and other agencies. A vast majority of the spores thus distributed undoubtedly fall in uncongenial places and fail to develop; but occasionally one lodges in a suitable place on the bark of some limb. We found in our work that such spores germinated readily at a temperature of 22°C (72°F), but that at a temperature of 29°C (84°F) germination was indefinitely delayed. It therefore seems certain that the spores do not germinate during the summer when the delicate germ tube would be killed by the extreme heat and by lack of moisture; but as we have seen that mature spores are present in immense quantities early in October, and probably considerably earlier, it is fair to assume that they start to germinate soon after the cool fall rains begin. Whether the mycelium of the germinating spore penetrates the cuticle of the apple bark or whether it gains access to the inner tissues through some slight crevice has not been determined as yet. However, after gaining access to the living tissues the mycelium ramifies through them absorbing the nourishment upon which it grows, and killing the surrounding cells. During the winter, as previously stated, the growth of the fungus and the consequent spread of the disease is slow, but in spring the mycelium takes on a renewed activity which is shown by the rapid spread of the disease. In May or early in June, the fungus reaches the fruiting stage and from that time all its energies are devoted to the production of spores and the diseased areas cease to spread. Whether the mycelium, having accomplished the object of its existence, the accumulation of nourishment for the production of spores, then dies,

or whether it merely enters a resting stage to be again stimulated to renewed activity by the fall rains, has as yet not been determined, although it has an important bearing upon the means to be employed in controlling the disease as will be shown later.

THE FUNGUS THE CAUSE OF THE DISEASE.

We have stated above that the disease is caused by the fungus *Glesporium malicorticis*. It may be of interest to the orchardist to know upon what evidence we base the assertion. It is not necessary to give at this time all details of the work which have led us to the conclusion. In brief, however, spores were induced to grow in artificial cultures. As they germinated they were examined under the microscope, their positions carefully marked, and when they had developed to such an extent that they could be seen by the unaided eye, they were separated from all other growths and transferred to tube cultures. This process was repeated many times and in different ways to eliminate all sources of error. When convinced that no other living organism was present in the tube cultures a number of sections of apple limb were inoculated with this "pure culture" of the fungus. In about a week after these inoculations were made, slightly discolored areas were observed about several of the points of infection, and in three weeks these areas had developed all the characteristics of the disease as seen in nature; being brown, distinctly depressed and separated from the surrounding living portions by the irregular ragged fissures. Having thus succeeded in producing the disease by inoculating with the fungus we are justified in asserting that the fungus is the cause of the disease.

REMEDIES.

Before any experiments in controlling the disease could be intelligently undertaken, it was necessary to know something of its nature. Having shown that it is caused by a certain fungus, the question of most interest is, can it be controlled? And, if so, how? My absence from the state, while studying the fungus itself, necessarily prevented me from conducting any experiments in controlling it, but from what I now know of the disease I believe that I may safely assert that it can be controlled. We have seen that the spores are developed and probably distributed during the late summer and fall months and that they undoubtedly germinate after

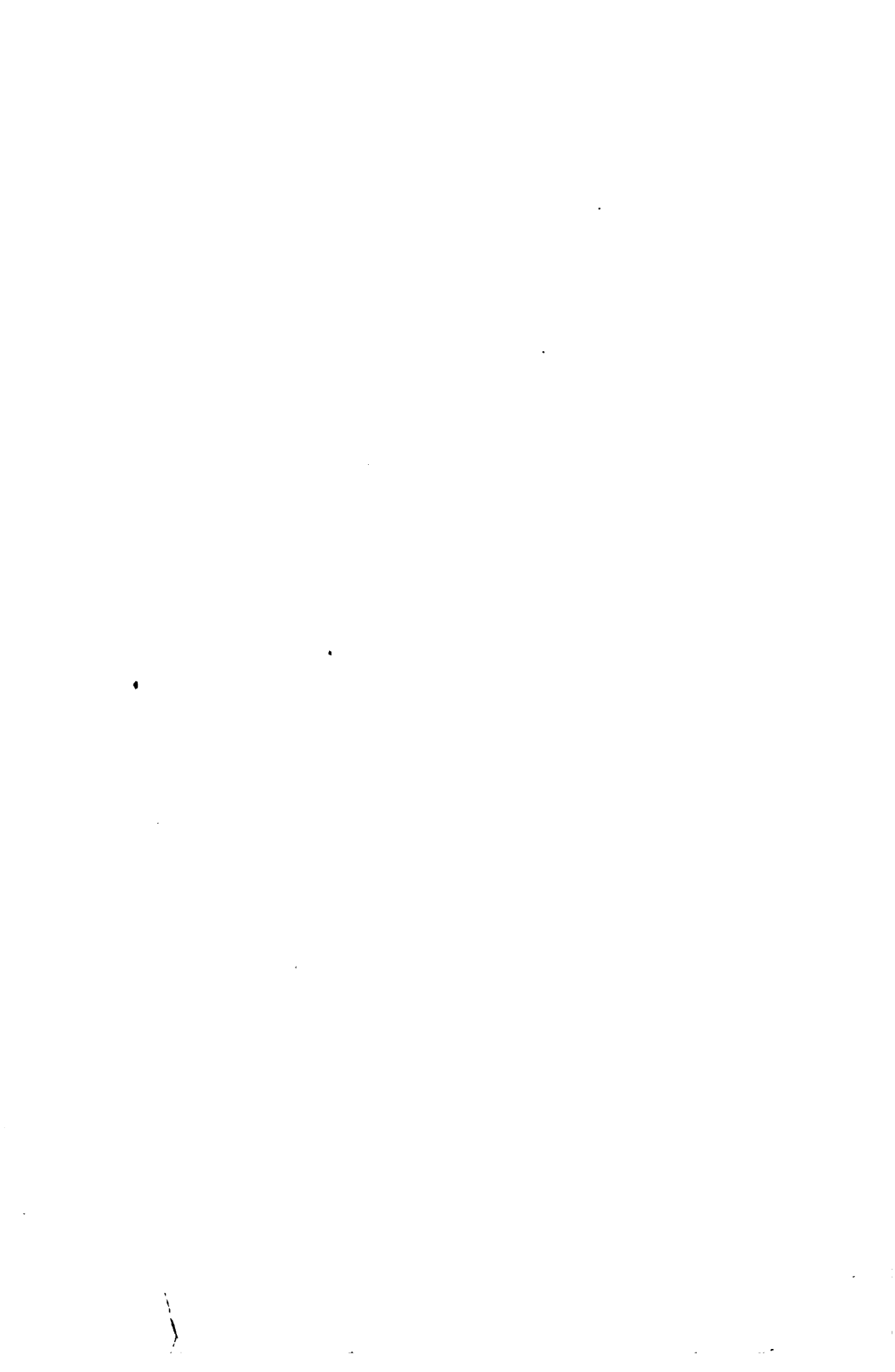
the fall rains begin. It is also known that bordeaux mixture and other copper compounds prevent the germination of the spores of most fungi. We therefore infer that if the trees be thoroughly sprayed with bordeaux mixture or with the ammoniacal solution of copper carbonate, once soon after the fall rains begin and again as soon after the leaves fall as possible, the germination of the spores will be largely prevented and the spread of the disease be thereby checked. It is not expected that such a process will exterminate the disease, but it is believed that it will so reduce its ravages that it can no longer be considered a menace to the apple growing industry. For the latter of the two applications mentioned above bordeaux mixture, winter strength, should be used. For the former bordeaux, summer strength, may also be used, but if fruit is on the trees it would be better to use the ammoniacal solution of copper carbonate. Whichever spray is used should be thoroughly applied and applied as soon as possible after the fall rains begin. The fungus cannot be destroyed by sprays after it has once entered the tissues of its host.

In addition to the sprayings recommended, we should advise owners of young orchards or orchards but little diseased, to carefully cut out and paint over with strong bordeaux all anthracnosed spots that may be observed. As stated in a preceding paragraph, it is possible that the mycelium of the fungus in the dead area of bark, after resting through the summer, may be stimulated to renewed activity by the fall rains and thus itself be an additional means of propagating the disease. Should this be the case, which we are at present inclined to doubt, spraying will not be entirely efficient in preventing the spread of the disease. For the present at least, or until the above supposition can be proved or disproved, it will be advisable to supplement the sprayings by using the knife wherever practicable. Old, badly diseased orchards can best be renovated by pruning severely and spraying thoroughly.

A. B. CORDLEY.



PLATE I.



5000.

Bulletin No. 61.

March, 1900.

CHEMICAL DEPARTMENT.

OREGON AGRICULTURAL EXPERIMENT STATION,

CORVALLIS, OREGON.

THE OREGON PRUNE.

Its Composition, Food Value, Soil Draught.

By G. W. SHAW, CHEMIST.

The Bulletins of this Station are sent Free to all Residents of Oregon who request them.

AGRICULTURAL COLLEGE PRINTING OFFICE,
GEO. B. KEADY, PRINTER.
1900.

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E. F. Pernot.....	<i>Bacteriology.</i>
J. F. Fulton, B. S.....	<i>Chemistry.</i>
C. M. McKellips, Ph. C.....	<i>Chemistry.</i>

The Oregon Prune.

IN Bulletin No. 45 of this Station appeared an article entitled "The Composition of Oregon Prunes." Since the publication of that article numerous analyses of both fresh and cured fruit have been made for various purposes. The present Bulletin collects and discusses the results of these analyses. It is a continuation of the work there reported and in some measure the former results are here included in order to bring the comparisons to date. A comprehensive review is here given of the proximate composition of Oregon prunes which is of value both from a scientific and a practical standpoint:

First, in giving the composition of different varieties, thus furnishing a point of departure for development along certain desired lines.

Second, in contributing to our knowledge of the average composition of the fruit, thus giving a basis of comparison in the study of food values; the physical data (proportion of pits to flesh, etc.) showing the relation of waste to actual food material; the chemical data a basis for comparing the nutrients of the prune with those of other fruits.

The work here presented is too meagre for rigid comparison but it is sufficient to give a close approximation to the character of this fruit. Questions of the influence of climate, soils, and fertilizers, as well as of those pertaining to fruit curing, will require much more exhaustive work than this Station has yet been able to do. These are questions requiring a large amount of time and painstaking labor, and, amid the multitudinous duties pressing in other directions, progress will necessarily be slow.

Composition of the Prune.

The composition of the prune may be expressed as follows:

Fruit	{ (1) Juice.	{ Water.	{ Sugar. Pectin. Albumenoids. Acids.
		{ Soluble Solids.	
	{ (2) Pulp.	{ Cellulose.	
		{ Carbohydrates. Pectose.	

During the process of ripening the first division is increased much at the expense of the second.

WATER.—This constitutes a very large proportion of all fruits in the fresh state, ranging from about 65 per cent. to 90 per cent. In the prune it ranges from 65 to 85 per cent. as will be seen on referring to the tables which appear elsewhere in this Bulletin. This water is no different from that occurring elsewhere in nature.

SUGAR.—This exists in fruits mainly as grape or fruit sugar which is widely diffused in nature. It is much less sweet than cane sugar. In fruits this sugar is developed from starch and cellulose during the process of ripening as will be discussed later.

PECTOUS BODIES.—These important bodies are scarcely ever wanting in fruit juices. They are substances, which, on proper boiling of the juice, causes it to form a jelly. The gummy exudation on a baked apple consists of a mixture of these pectous bodies. The pectin of the juice is formed by a chemical change from the pectose of the pulp which is a very characteristic constituent of unripe fruit.

ALBUMENOUS SUBSTANCES.—This is a class of bodies which contains about 16 per cent. of nitrogen and is commonly estimated by a determination of that element. They comprise vegetable albumen, fibrin and gluten. They constitute a very important class of bodies inasmuch as it is their function, and theirs alone, to form flesh or muscle in the body.

THE ACIDS.—The acids of fruit juices are malic and citric, the former constituting the chief sour principle in the case of prunes. These acids are usually accompanied by a small amount of tartaric acid.

CELLULOSE OR VEGETABLE FIBRE.—This occurs in all parts of all plants. It is this which gives strength and toughness to vegetable matter and forms its framework. It is closely related to starch from which it is formed. It is well represented by the fibre of cotton, hemp and flax.

ASH.—The ash, or inorganic constituent of fruit, represents the mineral matter which has been removed from the soil. It comprises various salts of potassium, sodium, magnesium, iron, calcium, etc., combined with phosphoric, sulfuric, hydrochloric and silicic acids.

Method of Analysis.

AVERAGE WEIGHT.—A convenient number of prunes was weighed and from the result thus obtained the average weight of the single plum was calculated as well as the number required to weigh one pound.

FLESH AND PITS.—The pits were then removed, and after being carefully freed from all adhering flesh, were weighed. The difference between the original weight and the weight of pits being taken as that of the flesh.

JUICE AND PULP.—One hundred grams of the flesh thus obtained were weighed into a counterpoised wet linen cloth and subjected to great pressure in a juice press so long as juice could be obtained. The material remaining in the cloth was weighed as *pulp*.

WATER AND DRY MATTER.—About 20 grams of the flesh were thinly sliced from several of the prunes and dried on a watch glass in an air bath, at first at a temperature of about 95° C, and finally at a temperature of 105° C.

ACIDITY.—Fifty grams of fresh flesh thoroughly bruised in a mortar were macerated in a beaker for 30 minutes, during which time it was thoroughly stirred several times. The pulp was then filtered out by means of a pump and the filtrate made to 500 cc. It was necessary to decolorize the solution quite carefully for the coloring matter was found sensitive to alkali used in the titration, and the color was in a measure restored by that agent, rendering the end reaction in titration dim. For determining acidity 50 cc of the above solution was titrated with tenth-normal potassium hydrate using phenolphthalein for an indicator.

SUGAR.—This was obtained by Fehling's method. For this purpose 100 cc of the solution prepared above were treated with 10 cc concentrated hydrochloric acid and kept at a temperature of 69° C for 10 minutes. The solution was then neutralized with sodium carbonate. Fifty cubic centimeters of this solution were then made to 100 cc and treated with Fehling solution as follows: Ten cubic centimeters of the Fehling solution were diluted to 50 cc and heated to boiling and the solution of juice run in from a burette. The mixture was then boiled exactly one minute and tested for copper. This operation was repeated till the minimum amount was found which would precipitate all the copper.

NITROGEN.—The official Kjeldahl method was used for this determination, using ten grams of the flesh.

ASH.—This was obtained by burning in a muffle furnace a convenient weight of the flesh till a white ash remained.

TABLE I, SHOWING COMPOSITION OF PETITE PRUNES (OREGON).

Laboratory Number.	Grower.	Postoffice.	Average Weight (Grams).	Number per Pound.	Percentage of Flesh.	Percentage of its.	Flesh.		Sugar.			Acidity, Terms of SO ₂ .	Nitrogen in Flesh.	Albumenoids, N. x 6.25.	Proximate Composition.		Ash.
							Juice; per cent.	Pulp; per cent.	In Flesh; In Per cent.	In Juice; In Per cent.	In Fruit; In Per cent.				Water.	Organic Matter.	
590	H. F. Fisher	Corvallis	30.5	14.8	95.08	4.92	78.5	26.5	17.52	23.02	16.66	.61	.265	1.66	75.28	24.29	.45
587	E. Witham	Corvallis	23.0	19.7	92.00	8.00	75.0	25.0	8.90	11.86	8.19	.65	.233	1.56	83.41	15.57	1.02
720	J. R. Shepard	Zena	17.7	25.7	92.60	7.40	75.7	24.3	15.08	19.79	14.04	.12	.240	1.24	77.70	21.67	.63
733	J. R. Shepard	Zena	24.2	18.7	94.12	5.88	80.0	20.0	16.54	20.67	15.61	.14	.175	1.09	70.25	29.02	.73
981	Station	Corvallis	21.0	15.0	92.86	7.14	74.0	26.0	14.30	19.32	13.78	.22	.....	.....	74.35	25.04	.58
987	A. Sharples	Goshen	23.9	19.1	93.72	6.28	82.0	18.0	12.94	15.78	12.13	.22	.....	.....	66.90	32.01	1.09
1044	E. W. Skinner	Springbrook	20.3	22.3	94.15	1.85	83.0	17.0	14.11	17.00	8.50	.30	.....	.....	67.98	31.43	1.59
1042	E. W. Skinner	Springbrook	22.4	20.2	97.13	2.87	87.0	13.0	8.75	10.06	17.47	.40	.142	.89	67.98	31.53	.88
1048	J. R. Shepard	Zena	16.5	27.4	93.49	6.51	70.0	30.0	18.68	26.69	12.80	.44	.130	.81	68.34	30.75	.91
1049	J. R. Shepard	Zena	16.3	27.8	94.60	5.40	90.0	10.0	11.52	12.90	10.90	.....	.137	.86	72.83	26.37	.80
1053	J. R. Shepard	Zena	27.7	17.5	97.29	2.71	85.0	15.0	13.31	15.66	12.95	.....	.180	1.13	70.38	28.85	.77
955	A. Riddle & Son	Riddle	15.8	28.6	92.40	7.60	76.0	24.0	12.60	16.58	11.64	.18	.170	1.06	74.11	25.22	.67
585	John Hall	Myrtle Creek	29.2	15.5	92.17	7.83	78.6	21.4	16.42	20.89	15.13	.65	.....	.....	72.26	26.98	.76
	Grand average.	Willamette Valley	22.2	20.4	94.26	5.72	78.6	21.3	13.89	17.70	13.14	.35	.181	1.14	72.45	26.77	.78
	Average.....		22.1	20.5	94.64	5.36	79.5	20.5	13.78	17.51	13.09	.34	.183	1.16			

TABLE II, SHOWING COMPOSITION OF FRESH ITALIAN PRUNES (OREGON).

Laboratory Number.	Grower.	Postoffice.	Average Weight (Grams).	Number per Pound.	Flesh.				Sugar.		Acidity, Terms of SO ₂ .	Nitrogen in Flesh.	Albumenoids, N. x 6.25.	Proximate Composition.		Ash.	
					Percentage of Flesh	Percentage of Pits.	Juice pressed: Per cent.	Pulp: per cent.	In Flesh: Per cent.	In Juice: Per cent.				In Fruit: Per cent.	Water.		Organic Matter.
579	Wm. Hartless	Corvallis	29.5	15.4	97.29	2.71	75.8	24.2	14.04	18.55	13.66	48	212	1.33	74.28	24.09	1.63
598	J. D. Johnson	Corvallis	31.5	14.4	95.28	4.72	68.2	31.8	11.44	16.77	10.89	92	170	1.06	75.34	24.78	.88
721	J. R. Shepard	Zena	32.1	14.2	94.56	5.44	70.2	29.8	8.52	12.13	8.08	37	180	1.06	69.92	29.07	1.01
982	Station	Corvallis	36.0	12.6	94.56	5.44	47.0	53.0	11.80	25.11	8.08	31	200	1.24	74.49	24.61	.90
1088	E. W. Skinner	Springbrook	27.0	16.8	94.63	5.37	54.0	46.0	10.02	12.52	9.48	25	181	1.13	81.47	17.72	.81
1041	E. W. Skinner	Springbrook	29.5	15.5	95.08	4.92	84.0	16.0	9.09	9.99	8.82	25	164	1.02	81.09	18.00	.91
1047	J. R. Shepard	Zena	25.3	17.8	92.30	7.70	84.0	16.0	9.09	9.99	8.82	25	164	1.02	72.76	26.36	.84
1050	J. R. Shepard	Zena	25.6	17.7	94.37	5.63	91.0	9.0	12.50	15.63	11.74	142	189	1.10	79.67	19.44	.89
973	J. B. Riddle	Riddle	27.4	16.2	93.95	6.05	80.0	20.0	11.80	18.15	11.15	22	140	.87	78.18	21.00	.82
975	J. B. Riddle	Riddle	27.6	16.1	94.50	5.50	65.0	35.0	11.80	18.15	11.15	22	140	.87	83.55	15.66	.79
584	John Hall	Riddle	36.6	12.4	93.01	6.99	61.0	39.0	12.92	21.28	12.01	181	1.13	1.13	77.89	21.24	.87
	Average of all Italians		29.8	15.4	94.39	5.62	76.4	23.6	11.56	16.12	10.82	42	174	1.09	77.07	21.99	.94
	Average for Willamette Valley		29.5	15.6	94.50	5.50	80.3	19.7	11.09	14.61	10.25	37	184	1.16	76.03	23.09	.86

* Probably incorrect; not included in averages.

TABLE III, SHOWING COMPOSITION OF FRESH SILVER PRUNES (OREGON).

Laboratory Number.	Grower.	Locality.	Variety.	Weight in Grams.	Number per Pound.	Per cent of Flesh.	Per cent of Pits.	Flesh.		Sugar. Per cent.			Acidity in terms of SO ₂	Nitrogen in Flesh.	Albumenoids, N. x 6.25.	Proximate Composition.		
								Juice, pressed; Per cent.	Pulp; per cent.	In Flesh.	In Juice.	In Fruit.				Water.	Organic Matter.	Ash.
581	H. F. Fisher	Corvallis	Silver	47.8	9.5	95.29	4.71	75.5	24.5	10.26	13.59	9.77	.42	.257	1.61	81.43	18.00	.57
588	D. C. Rose	Corvallis	Silver	57.0	7.9	98.18	6.82	63.2	36.8	15.15	23.97	14.03	.65	.170	1.06	69.91	29.02	1.07
722	J. R. Shepard	Zena	Silver	36.3	1.24	92.77	7.23	83.0	17.0	14.80	17.83	13.80	.24			77.58	21.71	.71
974	A. Riddle & Son	Riddle	Silver	61.5	7.3	93.89	6.11	89.0	11.0	16.67	18.73	15.65	.23	.272	1.70	77.54	21.73	.73
983	Station	Corvallis	German	23.0	19.7	91.30	8.70	87.0	13.0	13.39	15.38	12.23	.18	.172	1.05			
984	Station	Corvallis	Shannon	38.0	11.9	94.74	5.26			14.11		13.37	.19	.141	.87			
	Average			43.9	11.4	93.53	6.47	79.5	20.5	14.06	17.30	13.14	.32	.203	1.26	76.61	22.62	.77

TABLE IV. STATEMENT OF AVERAGES.

	All Prunae.	Petites.	Italians.
Weight in grams	29.8	22.2	29.8
Number per pound	15.5	20.4	15.4
Per cent of flesh	94.5	94.28	94.39
Per cent of pits	5.5	5.72	5.62
Flesh } Per cent. of juice	81.7	78.6	76.4
} Per cent. of pulp	18.3	21.3	23.6
} Per cent. in flesh	13.12	18.89	11.56
Sugar } Per cent. in juice	16.06	17.70	16.12
} Per cent. in fruit	2.39	18.14	10.82
Acidity (as SO ₃) of flesh	.85	.85	.42
Nitrogen in flesh	.183	.181	.174
Albumenoids in flesh	1.14	1.14	1.09
Water	77.37	72.26	77.07
Organic matter	22.62	26.98	21.99
Ash	.83	.76	.86

A Discussion of the Results.

The range of all analyses was from 15.8 grams in Italian 955 to 61.5 grams in Silver 974, the average being 29.3 grams, thus requiring 15.8 prunes to the pound. The average weight of Petites was 22.2 which is to be placed against 23.6 grams the average weight of California Petites so far as published. The average weight of Italian prunes was 29.8 grams. The widest range is seen in Petites 15.8 grams to 30.5 grams; the Italian ranged from 25.3 to 36.6 grams. In Bulletin 45 attention was called to the large size of sample 584 grown in the Umpqua valley, but this wider range of analyses indicates that there is really little difference in the size of the fruit grown in the Umpqua valley and the Willamette valley.

PROPORTION OF PITS TO FLESH.—The percentage of pits range from 1.85 in Petite 1044 to 8.70 in German 983. The relation of pits to flesh is shown to be as follows in the two leading varieties: Petites 1:16, Italian 1:16.7, the latter of which is about the same as the average for all analyses made. The results still show the Oregon prune to carry a little larger pit than the California fruit.

The tentative relation given in a former publication for the proportion of pits to flesh in the Petite (1:14) is shown to have been a little too narrow, and that for the Italian (1:17) a little too wide. In the light of this larger number analyses it would appear that Petites carry about 16 times as much flesh as pits, and Italians about 17 times as much. Measured by the proportion of flesh, then, the Italian seems to be the more economical of the two varieties, but when the per cent. of water is taken into account the Petites should be given the preference.

JUICE AND FLESH.—As compared with the Italian the Petite shows the largest proportion of juice to flesh, the average for the latter being 78.6 per cent. and for former 76.4. If, however, the Silver prune be considered in a sufficient number of analyses it would probably be found to carry even a higher per cent. of juice than the Petite.

SUGAR AND ACID.—It is about the sugar content of the prune that the chief interest centres. Examination of the table shows the average sugar content of all samples examined to be 13.12 per cent. *in the flesh*, the soft fleshed Petite ranging a little above the average and the Italian somewhat below. The Petite has the advantage of the Italian by 2.33 per cent., 13.89 per cent. against 11.56. The California Reports show the French prune to contain on an average (13 analyses) 23.96 per cent. *sugar in the juice* which shows a difference when compared with ours on the same basis, of about 4 per cent. in favor of the California grown fruit. The average sugar content is related to that of California prunes as 16.06 to 20 per cent. sugar in the juice. From the difference in climatic and soil conditions this is no different than we might expect.

Contrasting the Oregon fruit with 16 per cent. of sugar in the juice with that of Germany carrying 6.15 per cent. sugar we see that the home product is nearly three times as rich in this ingredient.

In their acid content the prunes examined present a wide variation. The average acidity in terms of sulfuric acid was found to be .35 per cent. which was the same as that found for the Petite prunes. The Italians showed an average acid content of .42 per cent. This larger acid content and the smaller sugar content giving this variety of prune its marked characteristic in respect to acidity.

ALBUMENOIDS.—Of this important class of bodies the maximum, 1.70 per cent., is found in Silver 974, and the minimum, .81 per cent., in Petite 1049. The average for Petites was 1.14 per cent. in the flesh against 1.09 for Italians still giving the Italians second place as was indicated in our former publication. In this connection it is interesting to note that the reports of California analyses (20) show as an average .837 per cent. albumenoids in the flesh against 1.14 per cent. for Oregon fruit. No analyses showing the albumenoids in the edible portion of European prunes is at hand, but in the whole fruit it is reported to be .78 per cent.

Food Value of Fresh Prunes.

PROXIMATE COMPOSITION.--A study of the data given in the table under this head shows that fresh prunes cannot be regarded as having a high food value carrying as they do an average of 77.37 per cent. of water. Of the two leading varieties grown here the Petites seem to have the largest per cent. of organic matter—26.98 for Petites against 21.98 for Italians. Considered from this standpoint fresh prunes would have about the same food value as vegetables, which may be shown by a few analyses as follows:

TABLE V.

	Water.	Dry Matter.	Protein.	Nitrogen free Extract. Including fat and fibre.	Ash.	Acid.
Fresh Prunes (Oregon; all prunes)	77.37	23.46	1.14	21.14	.83	.35
Fresh Prunes (Oregon; Petites)	72.26	27.74	1.14	25.49	.76	.35
Fresh Prunes (Oregon; Italians)	77.07	22.93	1.09	20.56	.86	.42
California (all prunes)	80.20	19.80	.80	18.50	.50	.40
Plums (California)	78.40	21.60	1.00	20.10	.50	.40
Cherries (Oregon)	81.30	18.70	.90	17.30	.50	.....
Cherries (California)	79.40	20.60	1.20	19.00	.40	.....
Potatoes	78.30	21.70	2.20	17.50	1.00	.....
String Beans	89.20	10.80	2.30	7.70	.80	.....
Turnips	90.46	9.54	1.14	8.63	.80	.....

A limited number of dietary studies have been made in this country to ascertain the effect of a liberal use of fruits and vegetables on the cost of living and in this connection the results are interesting. The results of these experiments show the liberal use of either fresh fruits or vegetables increases the cost of living out of proportion to the nutrients furnished.

However, it should be remembered that the value of an article of diet should not be measured entirely by its nutrients, as certain foods undoubtedly have a certain medical and mechanical effect in stimulating the appetite and counteracting any tendency to constipation. Prunes appear to be especially beneficial in this respect. Although containing a relatively small amount of nutrients they are nevertheless a very valuable article of diet and should find a wider use in the American household.

Soil Draught of the Prune.

THE ASH AND ITS COMPOSITION.—The ash ingredients are among the more important considerations of any crop for they represent the materials extracted from the soil. The following taken from the pen of Prof. W. F. Massey is so apt that I quote: "There is no doubt that the many failures in fruit production in the East are due to the exhaustion of the important elements of plant food in the soil. The farmers realize the importance of keeping up the fertility of the soil for the production of their annual crops of grain and vegetables, but somehow the idea has been prevalent that a tree can take care of itself. Men look at the great trees of the forest and see how they grow and that the soil increases in fertility under their influence, and think that the same should be the result in the growing of fruit trees, while they are carrying off continually not only the fruit that the orchard produces, but in many cases expect the land also to produce food for their stock, and then when the orchard fails to give the expected fruit, and this decrepit condition makes the trees alike prey to insects and fungous diseases, they declare that the climate has changed and they can no longer produce crops for that reason. It has really been because they and their fathers have robbed the soil until the needed food for the production of healthy trees and fruit is no longer available."

There is an old trite saying that "forewarned is forearmed" and it is well worth the while of the horticulturist to heed this warning for he has no recourse to crop rotation, but makes a constant and one-sided drain upon his soil which will surely show the effect of such cultivation either in a lack of proper fruit development or a constitutional disease of the tree.

Work in this direction has progressed sufficiently to give some valuable indications for the future, and when taken into account with the investigations made concerning the soils of the state* the data seems to confirm the results there given and to indicate the future needs of orchards in western Oregon.

No complete analyses of the ash of any of the fruits have been made, the work having been limited to the ash and those ingredients important from the standpoint of fertilizing. By referring to the "Statement of Averages" on page 9 it will be noted that the Petite prune draws measurably less on the soil than does the Italian. Considered as a whole, our prunes appear to draw more heavily on

* Oregon Bulletin No. 50.

the soil than do those of California, and it is also interesting to note that in this respect the latter fall below the draught by European prunes which stand about midway between those of Oregon and California. The conditions in this respect are set forth in the following table:

TABLE VI

Showing Plant Food Extracted from the Soil by Certain Fruits.

FRUITS.	Per cent.	Per cent. in Total Ash.				Pounds Removed in 1000 Lbs. of Fruit.				
		Total Ash.	Potash.	Phosphoric acid	Lime.	Nitrogen.	Total Ash.	Potash.	Phosphoric acid	Lime.
						Per cent.				
PRUNES:										
Oregon	.83	53.61	15.60	.....	.....	.220	8.3	4.45	1.30	.....
California	.49	63.83	14.08	4.66	.....	.162	4.9	3.10	.68	.....
European	.63	59.19	10.79	.....	.....	.122	6.3	3.73	.96	.....
CHERRIES:										
Oregon	.50	40.37	11.06	1.08	.....	.169	5.0	2.01	.55	.05
European	.58	34.83	10.34	.....	.....	.180	5.8	2.00	.60	.....
STRAWBERRIES:										
Oregon	.42	39.86	13.99	4.20	.....	.190	4.2	1.67	.59	.18
Other Localities	.60	50.00	23.31	.....	.....	.150	6.0	3.00	1.10	.....
Apples (average)	.39	48.72	2.56	.....	.....	.130	3.9	1.90	.10	.....
Wheat (grain)	1.57	24.84	44.58	.....	.....	2.36	15.7	3.98	7.00	.....
Oats (grain)	2.98	20.80	24.16	.....	.....	2.06	29.8	6.20	8.20	.....
Sugar Beets	1.04	46.17	9.61	.....	.....	2.20	10.4	4.80	1.00	.....

POTASH.—In the ash of prunes, cherries, strawberries and apples potash is the leading ingredient. In prunes and apples it constitutes about one-half of the total ash; in cherries it constitutes about two-fifths. Attention is called to the difference between the proportion of potash in the ash of the fruits and that of the grains, in the latter constituting only about one-sixth to one-fourth. Attention of horticulturists is especially called to this fact and still further to the fact that the soil conditions as set forth in Bulletin 50* are such as to demand close attention to this element. The soils of the Willamette valley are inclined to be weak in this ingredient due partly to a limited amount in the parent rock and partly to the heavy leaching to which the soils have been subjected. When fertilizers are used on the fruit orchards west of the Cascades they should invariably be rich in potash. It is quite likely that the low supply of potash of these soils has more or less to do with the smaller sugar content of the Oregon grown prune and the tendency

* This Bulletin can be had free on application to the Station.

to the trees themselves to succumb to fungus attacks. To gain some knowledge of the effect of potash salts applied to prunes some experiments were inaugurated a few years since, but on account of untoward circumstances the data so far obtainable has not been as definite as is desirable, although the limited results pointed toward an increase in the sugar content of the prunes.

This is in accord with the results obtained at the California station which indicated a slight increase in the sugar content of the orange, and also accords with the statement of Mr. Dosch, an observant horticulturist, as to a noticeable effect on his trees after a treatment with muriate of potash.

PHOSPHORIC ACID.—It will be noted that the fruits mentioned above draw more lightly on this ingredient than do the cereals. On account of the abundant supply it is not at all likely that phosphate fertilizers will be needed to any great extent on prune soils of the northwest.

NITROGEN.—This element is not an ingredient of the ash, but inasmuch as it is one of the most important from the standpoint of fertility it demands some mention. Of the fruits considered the prune draws most heavily on this element, but much less so than the cereals. On the bottom lands of the Willamette valley where the drainage conditions are very poor and the available lime supply quite limited, there will early be a call to replace this element by the use of leguminous crops. Such crops could be grown in winter to good advantage and turned under in the spring thus saving much plant food that would otherwise be lost through leaching. It is recommended also to make a liberal use of lime which will tend to improve the condition for humification by neutralizing the natural acidity of these soils. This also applies to the bench lands as they are as a rule more limited in their lime content than the bottom lands.

Fertilizer for Prunes.

In view of what is known relative to the soil conditions of western Oregon, I beg to suggest the following formula as probably being well adapted to the needs of fruits in general and prunes in particular:

Air slacked lime per acre	2000 lbs.
Muriate of potash	400 lbs.

This mixture may well be applied to some leguminous crop which is to be turned under as a green manure to furnish the nitrogen supply. Wood ashes may be substituted for the muriate if they can be obtained in considerable quantities at a reasonable price. It would take about 100 bushels of ashes weighing about 4500 pounds to be equivalent to the 400 pounds of muriate of potash. This application should be sufficient for several years. Fruit trees, being slow growing, appropriate plant food slowly and if it is thought best to use any phosphate probably nothing would be better than *finely ground bone*. No mention is made of this material as it is not likely to be needed, except in special cases. It should be borne in mind that no *specific rule* can be laid down in this matter of fertilizers as conditions are so variable, but the farmer must keep in mind general principles and use his intelligence in applying them to his conditions.

The Composition of the Cured Prune.

Of all the methods for preserving fruit none is of so great importance to the American people as that of fruit evaporation. Of all fruits so preserved the prune certainly takes first rank. The reader must not confound the term *evaporated* fruit with that of *dried* fruit of years ago, for the newer process gives a cured product much superior to the sun or oven dried article, retaining as it does much of the original color and flavor, being soft, pliable and palatable to eat out of hand. The process of evaporation has for its object primarily to drive off a sufficient amount of moisture to make the fruit keep, and to do this in such a manner as to leave the fruit in the condition above described and leave the flesh of a transparent appearance; a clear yellow in the case of the French prune, and an amber in the case of the Italian. No prune which has not these characteristics has been properly cured. It is not possible at this time to go into the technique of fruit curing, but rather to state the results of the analyses of samples of fruits cured by this method as they are found on the market.

TABLE VII. FOOD CONSTITUENTS OF PETITE PRUNES (EVAPORATED.)

Laboratory No.	Grower.	Locality.	Waste (Pits.)	Edible Matter (- Flesh.)	Water.	Dry Matter.	Albumenoids.	Sugar	* Carbohydrates	Ash	Acid as SO_2 .
724	J. R. Shepard	Zena, Polk	13.62	86.38	22.45	77.55	2.38	23.76	48.02	2.83	.56
726	J. R. Shepard	Zena, Polk	13.62	86.38	19.22	80.78	1.94	26.76	51.25	2.03	.28
728	J. R. Shepard	Zena, Polk	13.62	86.38	20.11	79.89	2.38	29.64	45.40	2.12	.35
729	J. R. Shepard	Zena, Polk	15.32	84.68	21.46	78.54	1.41	36.66	37.86	2.21	.40
730	J. R. Shepard	Zena, Polk	14.35	85.65	21.03	78.97	1.94	24.74	49.05	2.92	.32
731	J. R. Shepard	Zena, Polk	13.61	86.39	19.75	80.25	1.56	31.26	44.62	2.42	.39
734	J. R. Shepard	Zena, Polk			18.47	81.53	2.12	19.18	57.29	2.62	.32
735	J. R. Shepard	Zena, Polk			18.32	81.18	1.37	25.60	50.87	3.02	.32
736	J. R. Shepard	Zena, Polk			16.85	83.15	2.00	28.55	49.80	2.52	.28
988	A. Sharpless	Goshen, Lane	15.75	84.25	19.63	80.37	2.50	24.00	41.38	2.20	.29
1017	John Burnett	Corvallis, Benton	11.94	88.06	25.47	74.53	2.21	25.86	44.30	2.14	
1322	J. L. Haworth	Springbrook	19.00	81.00	17.26	82.74	2.32	25.86	52.31	2.25	
1323	C. F. Hoskins	Springbrook	9.20	90.80	17.88	82.22	2.87	25.85	45.15	2.25	
1329	J. R. Shepard	Zena, Polk	12.00	88.00	18.27	81.73	2.56	25.52	51.39	2.26	
1330	J. R. Shepard	Zena, Polk	11.00	89.00	18.02	81.98	2.12	25.16	52.11	1.49	
1333	J. R. Shepard	Zena, Polk	11.33	88.67	19.05	80.95	2.09	45.02	31.83	1.99	
1334	J. R. Shepard	Zena, Polk	9.80	90.20	18.96	81.04	1.94	34.99	43.96	1.61	.43
1481	Jas. Bond	Halsey, Linn	12.79	87.21	17.07	82.93	2.09	34.99	49.25	1.79	
1507	J. W. Wilkinson	Corvallis, Benton	18.75	81.25	11.88	88.12	2.09	34.99	49.25	1.79	
1512	G. S. Batty	Canby, Clackamas	8.74	91.26	19.33	80.67	1.94	30.01	45.51	3.21	
954	A. Riddle	Riddle, Douglas	15.73	84.97	19.46	80.14	1.97	20.00	56.63	2.54	
741	J. R. Shepard	Zena, Polk			25.82	74.18	2.43	27.36	42.49	1.58	.32
745	J. R. Shepard	Zena, Polk			18.54	81.15	2.00	22.92	45.99	2.05	.18
Average (23 analyses)			13.33	86.67	18.45	81.15	2.05	27.93	48.88	2.29	.34

* Including fat and fibre.

TABLE VIII. SHOWING FOOD CONSTITUENTS OF MISCELLANEOUS PRUNES (EVAPORATED)

17

Laboratory Number.	Grower.	Locality.	Variety.	Composition of Edible Matter.							
				Waste (Pits).	Edible Matter (Flesh).	Water.	Dry Matter.	Albumenoids.	Sugar.	*Carbohydrates.	Ash.
680	A. H. Carson	Grant's Pass	Silver.	13.23	86.78	14.41	85.59	2.62	45.00		1.97
681	A. H. Carson	Grant's Pass	Silver			14.46	85.54		40.00		
746	C. L. Daily	Salem	Silver	12.82	87.18	26.78	73.22	2.62	32.84	35.98	1.78
747	C. L. Daily	Salem	Silver	11.85	88.15	27.47	72.53	1.68	36.12	32.87	1.86
1018	B. F. Hoke	Corvallis	Silver	13.80	86.70	22.18	77.82	2.25			
1279	A. Riddle & Son	Riddle	Silver	13.80	86.70	22.18	77.82	2.25			
1280	A. Riddle & Son	Riddle	Silver	15.79	84.03	25.07	74.93	1.87	25.00		
1284	J. H. Skidmore	Wilbur	American Seedling	9.40	90.60	18.32	81.68	3.44	24.50	43.09	2.45
1321	J. H. Rees	Springbrook	Silver	13.00	87.00	18.12	81.88	2.31	32.50	55.54	2.03
1324	C. E. Hoskins	Springbrook	Willamette	11.10	88.90	18.35	81.65	2.00	28.70	46.85	2.11
1325	S. A. Mills	Newberg	Reine Claude	14.00	86.00	14.51	85.49	1.70	32.50	49.25	2.04
1326	C. E. Hoskins	Springbrook	Silver	10.00	90.00	16.22	83.78	2.31	23.50	65.89	2.08
1327	J. R. Shepard	Zena	Italian	17.00	83.00	13.88	86.12	2.63	34.99	26.05	2.45
1328	J. R. Shepard	Zena	Italian	21.00	79.00	25.39	74.61	3.12	28.35	42.77	2.37
1331	J. R. Shepard	Zena	Italian	16.90	83.10	25.89	74.61	2.44	25.52	49.01	3.19
1332	J. R. Shepard	Zena	Italian	15.60	84.40	21.49	76.51	2.50	38.38	35.60	2.03
1488	R. D. Allen	Silverton	Dosch	10.55	89.45	15.44	84.56	1.18	26.69	54.22	2.47
1505	J. C. Standish	Halsey	Dosch	15.38	84.62	18.74	81.46		41.70		2.83
1546	J. M. Wilkinson	Corvallis	Italian	13.53	86.47	17.01	82.99	2.30	29.18	48.82	2.69
1548	R. D. Allen	Silverton	Dosch	13.53	86.47	17.01	82.99	2.30	29.18	48.82	2.46
1511	G. S. Batty	Canby	Italian	12.21	87.79	20.55	79.45	1.94	25.25	49.73	2.26
	Average		Italian (?)	15.94	84.06	19.53	80.47	2.49	31.95	47.56	2.47
	Average		Silver (?)	12.78	87.22	20.76	79.22	2.17	31.13	44.08	1.94
	Average (44 analyses)			12.96	87.04	19.27	80.73	2.03	30.97	45.51	2.22

*Including fat and fibre.

AVERAGE COMPOSITION OF CURED PRUNES.

	All Prunes.
Waste (pits).....	12.95
Edible Matter.....	87.04
Water.....	19.27
Dry Matter.....	80.73
Albumenoids.....	2.03
Sugar.....	30.97
Carbohydrates (including fibre and fat).....	45.51
Ash.....	2.22
Total.....	80.73

There are two or three samples in the table which are worthy of special attention. The first is 1284, called by the grower, Mr. Skidmore, of Wilbur, Oregon, "The American Seedling." These I think were the finest prunes I have ever seen. Mr. Skidmore informed me that the fruit sent was not exceptionally large. It will be noted that the fruit carries over 90 per cent. of edible matter and is not approached in this respect by any except "The Dosch" and the Willamette. Another point worthy of note is the exceptionally high content of albumenoids, over one per cent. higher than the average. If the tree is horticulturally suited to the Oregon condition it is certainly worthy of close attention. Other varieties promising distinct advantages over either the Petite or the Italian from the food standpoint, would seem to be the Willamette and The Dosch. It is impossible to judge of the sugar value of any of these varieties till samples of the fresh fruit have been examined.

The average of all analyses shows prunes to contain about seven times as much edible matter as waste (pits). The fruit which had satisfactory keeping qualities carried about 20 per cent. of water. From the observations made I do not regard it as safe to leave a greater quantity of water than this in the fruit. In most cases where the fruit carried over this there was a tendency toward mould. Much of the fruit it will be noted carried considerable less than this, which accords with the idea of the better horticulturists that much of the product is overdried. The fact that this product carries about 80 per cent. of dry matter shows that it is of high food value. About three-eighths of this is composed of the carbohydrates which serve to develop energy and fat, hence prunes must be considered as essentially a fattening food and should be used with other foods rich in nitrogen.

Bulletin No. 62.

June, 1900.

CHEMICAL DEPARTMENT.

OREGON AGRICULTURAL EXPERIMENT STATION,

CORVALLIS, OREGON.

Miscellaneous Investigations.

By G. W. SHAW, CHEMIST.

The Bulletins of this Station are sent Free to all Residents of
Oregon who request them.

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Miscellaneous Investigations.

This bulletin collects the results of numerous analyses more or less relating to agriculture which have been made in this laboratory during the incumbency of the writer as chemist. These analyses have accumulated in three ways:—

(1) During the course of regular investigation of more extended character;

(2) From isolated analyses of materials which at the time were deemed of *sufficient public importance* to be undertaken;

(3) In the course of work for the State Dairy and Food Commissioner.

It has not been the policy of this department to make a large number of miscellaneous analyses, but to limit the work to matters of public importance rather than private interest, always reserving the right to publish the results of work in as much detail as the Station desired.

Sorghum for Syrup.

On the completion of the work with sugar beets (1898) plans were laid to investigate the possibilities of growing sorghum for syrup-making in certain parts of the state. The work was begun in the spring of 1899 during which season a quantity of seed was distributed in the state, especially in Jackson and Umatilla counties, where it was thought the conditions would be most suitable for the crop. In each of these counties sorghum had been grown on a very limited scale for a number of years and a crude syrup had been made for home use. No attempt had ever been made, so far as known to the writer, to ascertain the real quality of the cane as compared with that produced elsewhere. The seed employed in these experiments consisted of Minnesota Early Amber cane, purchased of Mr. Seth Kinney, Morristown, Minn., and the following varieties of pedigreed southern grown seed furnished by the U. S. Department of Agriculture: Early Amber, Brown Colman, and Folger's Early.

None of the southern grown varieties matured, but the Minnesota seed seemed quite well adapted to the Oregon conditions. The season was altogether unfavorable for the experiment and for one reason and another of the 79 to whom seed was sent, 51 failed to forward samples. In most of these cases the cane was killed by a quite general frost which occurred on or about October 2d in both eastern and southern Oregon, which is quite an unusual occurrence so early in the season, especially in Jackson county. The results of the analyses of the canes are presented below.

Laboratory No.	Grower	Postoffice	Planted	Cut	Longest Stalk Feet	Shortest Stalk Feet	Was Season Favorable?	Analyses of Juice.			
								Sucrose	Glucose	Total Sugar	Purity
1801	Lee Watkins	Central Point	April 25	September 30	8	5½	No	16.8	8.7	25.5	66.9
1803	S. I. Bennett	Medford	April 25	October 3	7½	4½	No	15.4	4.6	20.0	73.0
1804	T. A. Merriman	Medford	April 19	October 3	7½	4½	No	9.0	3.9	12.9	41.0
1805	T. B. Johns	Galeville	April 15	October 3	9½	5½	Yes	13.4	4.2	17.6	63.0
1806	Frank Wolf	Table Rock	April 15	October 4	8½	5	No	12.2	4.6	16.8	50.0
1807	E. W. Smith	Medford	May 10	October 4	8½	5	No	11.0	6.2	17.2	46.0
1808	E. H. Smith	Eagle Point	May 1	October 6	8½	6	Yes	13.0	5.5	18.5	63.4
1810	Thomas Andrews	Brickway	May 1	October 6	8½	6	Yes	13.7	4.6	18.3	67.0
1814	Thomas Andrews	Medford	May 15	October 9	7½	5½	No	14.6	4.2	18.8	61.1
1815	E. A. Hendricks	Talent	May 16	October 9	7½	5½	No	13.0	5.2	18.2	64.1
1815½	W. W. Estes	Medford	May 10	October 9	7½	5½	No	12.5	4.5	17.0	67.0
1816	E. P. Bennett	Medford	April 15	October 10	10½	6½	No	11.7	3.8	15.5	55.0
1817½	M. E. Dixon	Applegate	May 15	October 11	7½	4½	No	12.5	3.6	16.1	67.0
1824	I. A. Merriman	Medford	April 19	October 15	7½	4½	No	11.5	3.6	15.4	63.0
1825	A. Porter	Grave	May 10	October 15	9	5	No	13.2	3.6	16.8	60.0
1826	I. W. Smith	Eagle Point	May 10	October 20	10	6	No	10.5	4.1	14.6	65.0
1827	Noah Condit	Riddle	May 10	October 21	10	6	No	14.7	3.0	17.7	75.0
1828	E. A. Hendricks	Talent	May 16	October 21	10	6	No	15.2	3.2	18.4	74.0
1829	M. H. Tower	Ostland	May 9	October 27	7	4	No	7.8	4.7	12.5	60.0
1831	John Hall	Myrtle Creek	May 9	October 27	7	4	No	13.2	4.7	12.5	60.0
1831½	L. Oldenburg	Ladysburg	May 12	October 18	7	3	No	10.9	5.3	16.2	61.5
1831	K. J. Stackland	The Dalles	May 12	October 18	7	3	No	12.7	5.2	17.7	69.0
1818	Robert Jensen	Cove	June 7	October 7	9	5	No	6.7	6.1	12.8	40.4
1819	G. DeGraw	Milton	May 15	October 7	10	8	Yes	14.2	4.7	18.9	73.0
1819	L. B. Zell	Milton	May 15	October 10	8½	5	Yes	13.2	4.1	17.3	65.0
1820	G. Carmichael	Milton	June 4	October 4	11	6	No	8.0	5.5	13.5	48.4
1820	G. Carmichael	Weston	April 20	October 9	10	7	Yes	14.9	4.5	19.4	72.0
1823	J. R. King	Weston	May 10	October 9	10	7	Fair	10.3	3.7	14.0	60.2

The results show that a fair quality of sorghum for the purpose of syrup manufacture can be produced in Jackson county and probably in certain parts of Umatilla county. Experience of growers in the former shows that in ordinary seasons the early varieties of sorghum will well mature, but in the latter locality there will be much uncertainty as to the maturing of the crop. Under the present condition it is impossible to estimate the cost of the crop and the profit realized from it, but the most reliable estimates show that the cost of the syrup, ready for market, does not exceed 30 cents per gallon. Mr. E. H. Davis of Table Rock, Jackson county, reports that from a little less than one-half an acre he obtained 56 gallons of syrup. W. W. Estes states that from one-fourth of an acre he obtained 22 gallons of syrup. I believe the field is worthy of further investigation.

Strawberries.

There is but little literature touching upon the chemical side of strawberries. So far as I have been able to ascertain there has been published but one bulletin treating of the composition of strawberries, and in the annual reports of the Stations there is but one reference to this subject.* A few analyses of this fruit have been made at this Station and the results are here stated.

ANALYSES OF STRAWBERRIES.

Laboratory No.	Variety.	Average Weight. Grams.	Flesh. Per cent.	Waste (hulls). Per cent.	Sugar. Per cent.			Acid as Malic. Per cent.	Nitrogen. Per cent.	Albumenoids. N. x 6.25.	Proximate Composition.			
					Grape.	Cane.	Total.				Water.	Organic Matter.	Ash.	Total.
844	Michael's Early (1898)	2.39	94.47	5.53	3.07	1.59	4.66	1.08	.10	.62	91.52	8.15	.33	100
845	Vick's (189-)	10.66	97.27	2.73	3.21	.93	4.14	.95	.18	1.12	81.70	17.91	.39	100
846	Warfield (1898)	6.66	96.80	3.20	3.94	1.08	5.02	.89	.11	.69	90.45	9.18	.37	100
847	Glendale (1898)	11.30	97.00	3.00	3.27	.88	4.15	1.01	.18	1.12	88.23	11.45	.32	100
1343	Sharpless (1899)	5.55	97.54	2.46	---	---	6.18	.72	.18	1.12	88.22	11.42	.36	100
1344	Wilson (1899)	4.86	97.59	2.41	---	---	5.90	.80	.12	.72	88.14	11.20	.66	100
1345	Oregon Everbearing ('99)	6.96	96.56	3.44	---	---	10.00	.40	.10	.62	87.30	12.12	.58	100
1346	Magoon (1899)	18.33	97.38	2.62	---	---	6.18	.19	---	---	88.72	10.79	.49	100
1350	Clark's Seedling (1899)	8.43	95.36	4.64	5.44	.62	6.06	---	---	---	89.02	10.69	.25	100
		8.39	96.66	3.34	3.79	---	5.80	.75	.17	.86	88.57	11.43	.41	100

* Bulletin No. 4, Vol. II, Part 2, Tenn. Exp. Station, 1889, W. E. Stone, and 6th An. Report Ohio Station.

For the sake of comparison the following averages obtained by other workers are here stated:--

	Water.	Dry Matter.	Protein.	Total Sugar.	Acid.	Fibre.	Ash.
* European (J. König).....	87.66	12.34	.57	6.28	.93	2.32	.81
† Tennessee (W. E. Stone).....	90.52	9.48	.99	5.36	1.37	1.55	.62
‡ Ohio (H. A. Webber).....	-----	-----	---	4.50	1.00	---	---
Oregon.....	88.57	11.43	.86	5.80	.75	---	.41

From this it appears that the European strawberry is probably sweeter than the American berry, yet this would be governed much by the variety used in analysis, but they do not appear so rich in protein and probably carry more fibre. Comparing the mean of the averages of the American analyses with the European as to the relation of acid to sugar, it appears that in the latter the ratio appears as 1 to 7, while in the former it stands as 1 to 5. If this be compared with the ratio for wild strawberries, as stated by Fresenius, 1 to 2, it is seen there has been quite an improvement brought about by selection and cultivation.

From the above analyses it is seen that the strawberry can not be considered as a very nutritious food, carrying but little over 10 per cent dry matter. Strawberries have even less food value than the flesh of stone fruits. In a general way they may be stated to approximate vegetables in their nutritious properties which may be seen from the following table:

	Water.	Dry Matter.	Protein.	Nitrogen free Extract. Including fat and fibre.	As .	Acid as SO ₃
Fresh Prunes (Oregon; all prunes)	77.37	23.46	1.14	21.14	.83	.35
Fresh Prunes (Oregon; Petites).....	72.26	27.74	1.14	25.49	.76	.35
Fresh Prunes (Oregon; Italians).....	77.07	22.93	1.09	20.56	.86	.42
California (all prunes)	80.20	19.80	.80	18.50	.50	.40
Plums (California).....	78.40	21.60	1.00	20.10	.50	.40
Cherries (Oregon).....	81.30	18.70	.90	17.30	.50	.....
Cherries (California).....	79.40	20.60	1.20	19.00	.40	.....
Potatoes.....	78.30	21.70	2.20	17.50	1.00	.....
String Beans.....	89.20	10.80	2.30	7.70	.80	.....
Turnips.....	90.46	9.54	1.14	8.63	.80	.....
Strawberries (Oregon).....	88.57	11.43	.86	9.41	.41	.75

* Chemie d. Mensch Nahrungs u. Genussmittel, 1 Band (30 Ed.) p. 777.

† Tenn. Bul. Vol. 11, No. 4, 1899.

‡ 6th An. Rept. Ohio Ext. Station, 1881.

§ As Malic.

A limited number of dietary studies have been made in this country to ascertain the effect of a liberal use of fruits and vegetables on the cost of living and in this connection the results are interesting. The results of these experiments show the liberal use of either fresh fruits or vegetables increases the cost of living out of proportion to the nutrients furnished.

However, it should be remembered that the value of an article of diet should not be measured entirely by the nutrients, as some foods undoubtedly have a certain medical and mechanical effect in stimulating the appetite and counteracting any tendency to constipation by introducing into the system beneficial vegetable acids in a pleasant and agreeable combination with water and sugar. No fruit equals the strawberry in this particular. Though containing a relatively small amount of nutriment strawberries offer in this a very valuable article of diet and have a deservedly wide use in the American household.

Composition of Strawberry Ash.

A composite sample of the ash from strawberries was analyzed which is of interest inasmuch as it represents the draught on the soil. Only those ingredients were determined which are of importance from a fertilizing standpoint. The results, together with those from a few other fruits are expressed below:

Table showing Plant Food Extracted from the Soil by Certain Fruits.

FRUITS.	Total Ash. Per cent.	Per cent. in Total Ash.				Pounds Removed in 1000 Lbs. of Fruit.				
		Potash.	Phosphoric acid	Lime.	Nitrogen. Per cent.	Total Ash.	Potash.	Phosphoric acid	Lime.	Nitrogen.
PRUNES:										
Oregon	.83	53.61	15.60	.....	.220	8.3	4.45	1.30	.....	2.20
California	.49	63.83	14.08	4.66	.162	4.9	3.10	.68	.....	1.62
European	.63	59.19	10.79	.....	.122	6.3	3.73	.95	.....	1.22
CHERRIES:										
Oregon	.50	40.37	11.06	1.08	.169	5.0	2.01	.55	.05	1.69
European	.58	34.83	10.34	.....	.180	5.8	2.00	.60	.....	1.80
STRAWBERRIES:										
Oregon	.42	39.86	13.99	4.20	.190	4.2	1.67	.59	.18	1.90
Other Localities	.60	50.00	23.31	.....	.150	6.0	3.00	1.10	.....	1.50
Apples (average)	.39	48.72	2.56	.....	.130	3.9	1.90	.10	.....	1.30

Strawberries draw heavily on the side of potash and nitrogen, the former constituting about two-fifths of the entire ash. Any fertilizers used on strawberry plants should be relatively rich in both potash and nitrogen and I would suggest the following combination and amount per acre:

Nitrate of soda	200 pounds
Muriate of potash	250 pounds
Dissolved bone	200 pounds

It should be borne in mind that no scientific rule can be laid down in this matter of fertilizers, as conditions are so variable, but the farmer must keep in mind the general principles and use his intelligence in applying them to his conditions.

Cost and Composition of Bread in Oregon.

During the year 1899 analyses were made and data collected under the direction of the writer, to ascertain the cost and composition of bread in Oregon.* The study was made for the purpose of gaining some data for making comparisons with similar experiments conducted elsewhere, as well as to ascertain the relative cost per pound of the various nutrients contained in the bread.

The samples were collected from different parts of the state, including both eastern and western Oregon. In each case inquiry was made as to the claimed weight of the loaf, but in many instances no definite weight was claimed. In most cases the actual weight, as found in the laboratory, approximated very closely with the claimed weight. In a few instances the actual weight was found a little greater than the claimed weight.

The samples represented the bread as actually sold to the consumer, as in no instance did the merchant know for what purpose the bread was purchased. The moisture determination was made as soon as the bread reached the laboratory, and much care was taken to protect the loaves from loss of moisture after purchasing. In all 25 samples were examined. The samples after being air-dried were analyzed according to official methods. The results obtained are shown in the following table:

*Credit is due Miss Idella McBride for a portion of the work under this head, she having presented it in a thesis.

TABLE SHOWING COST AND COMPOSITION OF BREAD IN OREGON.

No.	Place of Purchase.	Trade Name.	Claimed Weight of Loaf.		Actual Weight of Loaf.		Cost per lb.		Composition of Fresh Bread			Calculated to Dry Matter		
			Pounds	Grams	Pounds	Grams	Actual Weight	Cost of Loaf	Water	Dry Matter	Fat	Carbohy- drates	Protein	Fat
							Cts	Cts	Cts	Cts	Cts	Cts	Cts	Cts
1	Salem	French Roll	None	88	400	2 1/2	3.1	31.51	68.49	7.68	1.43	58.55	80	11.21
2	Salem	None	None	71	320	2 1/2	3.5	35.07	64.93	7.10	1.04	55.60	1.19	10.63
3	Salem	None	7 1/2	340	77	348	2 1/2	3.3	61.23	6.51	.63	52.96	1.13	10.63
4	Salem	None	7 1/2	340	77	319	2 1/2	3.3	61.23	6.51	.63	52.96	1.13	10.63
5	LaGrande	Cream	1.19	539	1.00	453	4 1/2	3.3	4.3	29.83	1.05	54.17	1.19	10.11
6	LaGrande	Baker	1.25	557	1.17	531	4 1/2	3.3	70.17	6.06	.69	60.33	1.35	10.11
7	LaGrande	City	1.06	492	.97	438	4 1/2	4.0	64.96	6.96	.69	58.01	1.27	10.73
8	The Dalles	French	None	492	.97	438	4 1/2	4.0	64.96	6.96	.69	58.01	1.27	10.73
9	The Dalles	None	1.06	454	.85	385	5	5.0	70.94	7.70	.84	59.02	1.44	11.83
10	The Dalles	None	1.00	454	.91	415	5	5.0	68.62	7.78	.41	59.02	1.44	11.83
11	Milton	Pioneer	1.00	454	.91	415	5	5.0	65.49	7.75	.75	55.66	1.35	11.83
12	Portland	None	1.06	454	.91	415	5	5.0	67.46	8.10	.40	57.86	1.53	10.74
13	Portland	None	1.06	492	.67	303	3 1/2	4.7	62.95	7.18	.81	53.35	1.63	11.36
14	Portland	None	None	340	.77	348	2 1/2	3.8	64.07	7.78	1.13	53.83	1.27	12.15
15	Portland	Creamery	None	340	.77	348	2 1/2	3.8	61.87	7.78	.91	53.90	1.69	9.46
16	Portland	None	None	1.24	.579	579	5	8.0	66.72	6.64	.28	58.12	1.46	9.46
17	Portland	Steam	1.00	458	.97	445	3 1/2	3.8	64.72	6.64	.28	58.04	1.62	9.46
18	Portland	None	None	1.03	.467	467	3 1/2	4.4	65.72	6.64	.52	58.35	1.26	8.59
19	Portland	None	None	1.86	.390	390	3 1/2	3.8	61.94	7.83	1.09	50.44	2.41	10.96
20	Albany	Pullman	2.75	927	.87	846	10 1/2	5.0	64.19	5.78	1.73	51.51	1.14	9.64
21	Albany	None	2.75	927	.87	846	10 1/2	5.0	60.74	5.78	.27	53.04	1.29	9.00
22	Albany	None	1.50	686	.64	651	5 1/2	3.3	60.74	5.78	.27	53.04	1.29	9.00
23	Albany	None	None	1.34	.648	648	5 1/2	3.7	60.95	5.54	.04	52.62	1.70	8.75
24	Albany	None	2.56	725	.72	327	2 1/2	4.4	61.27	5.95	---	54.28	1.14	9.54
25	Albany	None	1.13	510	.37	622	5	4.4	60.95	5.66	.00	54.41	.98	9.28

* Not included in the average.

Discussion of Results.

"The variations in the composition of bread are chiefly due to two causes, (1) the variation in the composition of the flour used which may cause changes in two directions, (a) in the amount of water that may be absorbed by the bread and (b) in the proportion of protein, fats and carbohydrates; (2) the different methods used by bakers in making the bread. In some cases only flour, yeast and salt are used, while in others, milk, butter, sugar and lard, either alone or in combination are added.* The average composition of the bread as purchased and found by analysis is stated below:

Water	35.81
Protein	6.75
Fat	.80
Carbohydrates	55.26
Ash	1.38
Total	100

The widest range is seen to be in the fat, which varied from "trace" to 1.73 per cent. This variation in the fat of bread is considered to be due partially to certain changes which it undergoes in the process of baking, rendering the fat non-extractible, perhaps in some cases, destroying it. The results obtained for 11, 21, 22 and 25 are too low to be due to any brand of flour. The water content varied from 29.06 in sample 8 to 39.80 in sample 20. The difference in the moisture content is probably due to the different absorbing power of bread made in different ways.

In the case of protein there is not so wide a range, and the difference in this respect is probably due less to the method of making than to the difference in the composition of the flour. It is interesting to note that the breads made from eastern Oregon flour have a higher per cent of protein than do those analyzed from western Oregon. This is of greater interest since it tends to confirm the results that have been obtained in analysis of flour from these regions by Mr. E. J. Lea of this department. Mr. Lea's results, which have not yet been published, show as follows:

* Bulletin 35, U. S. Department of Agriculture.

Cost of Bread.

New Brunswick, N. J.	4.3
Trenton, N. J.	4.9
Newark, N. J.	3.8
Camben, N. J.	4.6
Average	4.4 cts
Salem	3.3
La Grande	4.0
The Dalles	5.6
Portland	4.3
Albany	3.6
Average	4.1 cts

From this it will be seen that bread appears to be very slightly cheaper here than in New Jersey which may, probably be taken as typical of the North Atlantic States. There appears, however, to be a greater uniformity in prices in New Jersey than in Oregon. The difference in price would indicate that there is a lack of uniformity on the part of bakers in fixing the price of the loaf. *Bread should be sold by the pound* and not by the very indefinite term "loaf," and then the purchaser would be able to know just what he is purchasing and pay for just the amount obtained.

Cattle Foods.

The following analyses of cattle foods have been made to date. It will be noted that analyses of a number of native clovers are presented. These clovers are all found in the vicinity and in some cases might prove useful plants if brought under cultivation:

TABLE SHOWING COMPOSITION OF SOME OREGON CATTLE FOODS.

SUBSTANCE.	Composition of Original Substance.								Calculated to Dry Matter.			
	Moisture.	Dry Matter.	Ash.	Protein—N x 6.25.	Fibre.	Nitrogen Free Extract.	Ether Extract.	Ash.	Protein—N x 6.25.	Fibre.	Nitrogen Free Extract.	Ether Extract.
1. Red Clover [Trifolium pratense].....	9.39 80.61	7.77	8.26	23.45	43.70	2.43	8.51	9.11	31.40	48.29	2.69	
2. Trifolium tridentum.....	9.51 90.49	7.28	7.00	27.20	47.21	1.80	8.45	7.75	30.05	51.87	1.98	
3. Trifolium eriocephalum.....	8.58 91.42	9.20	7.03	21.55	51.26	2.38	10.06	7.68	28.57	56.07	2.60	
4. Meadow Foxtail [Alopecurus pratensis].....	8.40 91.60	10.65	6.00	21.81	51.70	1.94	11.62	6.55	24.85	55.36	2.12	
5. English Rye Grass [Lolium perenne].....	6.93 93.02	7.00	3.50	23.20	56.72	4.60	7.52	8.76	24.94	53.83	4.95	
6. Cheat [Bromus secalinus].....	8.56 91.44	9.19	3.61	31.90	44.99	1.75	10.05	3.94	33.79	50.30	1.92	
7. Vetch [Vicia sativa].....	9.19 90.81	9.37	7.05	25.64	47.15	1.60	10.31	7.76	28.23	51.94	1.76	
8. Alsicke Clover [Trifolium hypridum].....	8.96 91.04	8.40	7.73	32.19	40.55	2.17	9.22	8.49	35.35	44.56	2.38	
9. Sweet Vernal [A. odoratum].....	10.81 89.19	8.10	8.20	23.38	46.49	3.02	9.08	9.19	26.21	52.13	3.39	
10. Spurry [S. maxima].....	8.54 91.42	8.62	4.81	14.70	59.09	4.20	9.42	5.26	16.08	64.63	4.59	
11. Trifolium ciliatum.....	10.29 89.71	9.58	10.06	22.20	45.93	1.94	10.92	11.47	25.31	50.19	2.21	
12. Trifolium incarnatum.....	11.51 88.49	7.43	10.92	29.09	37.89	3.16	8.81	12.34	32.87	42.91	3.57	
13. Trifolium grandifolium.....	10.06 89.95	9.16	10.66	12.07	55.02	3.04	10.18	11.85	13.41	50.05	3.38	
14. Orchard Grass [Dactylis glomerata].....	11.80 88.20	5.90	8.17	38.33	33.54	2.26	6.60	9.26	43.44	38.12	2.56	
15. Tall Oat Grass [Arrhenathenum avenaceum].....	14.30 85.70	7.28	10.88	24.36	42.82	2.41	8.43	12.69	28.42	52.34	2.80	
16. Meadow Fescue [Festuca pratensis].....	8.03 91.97	7.52	6.69	31.83	44.29	1.64	8.17	7.16	34.60	48.29	1.78	
17. Timothy [Phleum pratense].....	11.19 88.81	3.98	6.02	30.35	46.26	2.20	4.48	6.77	34.15	52.13	2.47	
18. Oat Straw.....	9.62 90.38	5.20	3.51	43.37	36.02	2.21	5.62	3.73	46.94	41.63	2.39	
19. Wild Barley [Hordeum maritimum].....	7.51 92.49	12.20	6.50	25.00	46.79	2.20	13.18	7.02	27.03	50.39	2.38	
20. Red Clover [Trifolium pratense].....	4.27 95.73	8.50	14.84	28.83	40.11	3.35	8.88	15.50	29.90	42.23	3.49	
21. Cheat [Bromus secalinus].....	7.00 93.00	9.09	7.67	31.80	42.49	1.95	9.77	8.24	34.19	45.70	2.10	
22. English Fescue.....	7.63 92.32	8.64	3.94	24.17	53.17	2.00	9.35	4.26	26.18	58.05	2.16	
23. Native Grasses [mixture].....	8.75 91.25	10.12	11.25	30.86	36.79	2.23	11.08	12.21	33.82	40.45	2.44	
24. Scallin.....	68.31 31.69	2.14	8.96	4.33	14.46	1.80	6.75	28.27	13.66	45.96	5.36	
25. Sugar Beet Pulp.....	89.01 10.99	7.0	8.1	2.40	6.43	5.8	6.37	8.00	22.02	58.33	5.28	
26. Salsify.....	77.07 22.93	4.0	3.21		*17.82	1.50	1.76	13.94		*77.89	6.37	
27. Wheat Shorts.....	9.61 90.39	4.24	5.62	2.84	76.31	1.38	4.67	6.22	3.14	84.44	1.53	
28. Wheat, Oats and Bran Mixture [equal parts].....	9.59 90.41	7.63	7.39	4.68	67.51	1.15	8.42	8.17	5.17	76.96	1.28	
29. Oat Chop.....	9.40 90.60	7.65	7.44	3.27	73.98	1.26	8.44	8.20	3.61	78.37	1.34	
30. Wheat Chop.....	9.76 90.24	7.93	7.59	4.31	69.17	1.27	8.79	8.41	4.77	76.62	1.41	

* Includes fibre.

Notes.

1. Sample taken from Station plat; was in full bloom; grown on drained "whiteland."

2, 3, 11, 12, 13 are samples of native clovers which grew on heavy soil; plants rather small except the last two. Cut when in full bloom.

4. Sample cut when in full bloom, June 8, 1893; cured in the laboratory and became somewhat bleached before analysis. The same remarks apply to samples 5, 7, 9, 10, 14, 15, 16, 17.

6. Sample sent by Wm. Bogue, Corvallis; a fair sample as cured by the farmer of the vicinity; slightly over-ripe at base of leaves.

20. Received March 3, 1896. Used in Cheat vs. Clover experiment (see Bulletin 47). Excellent sample; cut in full bloom.

21. Received March 3, 1896. Used in Cheat vs. Clover experiment (see Bulletin 47). Most excellent sample; cut in full bloom.

23. Sample of hay from a mixture of native grasses which grew in Union county near La Grande; considered by the stockmen very nutritious, which is borne out by analysis.

24. The sample was somewhat withered when received at the laboratory, hence the moisture is probably a little too low for a fair sample. The plant is remarkable for a high protein content, a fact also pointed out by the California Station.

25. Silage of sugar beet pulp from sugar factory at La Grande (see Bulletin 59). An excellent cattle food. Beet pulp is not a balanced ration and the best results can not be expected from feeding it alone, though it is a healthful and nutritious food. Its chief components are the carbohydrates and proteids. It is essentially a fattening food. Experience has shown that it is relished by dairy cattle and produces an excellent flow of milk when balanced with nitrogenous foods. The pulp is valuable not only as cattle food but also as food for hogs and sheep.

GYP SUM.

There is probably no place in the United States where gypsum could be used to greater advantage with a liberal hand than on the soils of Oregon, provided the material could be obtained at anything like a reasonable figure. At present, however, the prices are so high as to render it almost prohibitive except in certain special cases. This seems the more to be regretted, since within the state can be found as fine a quality of this material as at any other point in the country. So far as the writer has been able to ascertain, the only deposit of this material of any considerable extent occurs in eastern Oregon, principally near Huntington, although lesser deposits

have been reported from other localities. The only samples that have reached this laboratory have been from the point mentioned above. Analyses of several samples of this rock are presented below, as well as analyses made of a few samples from other sources:

TABLE SHOWING COMPOSITION OF OREGON GYPSUM.

	1289.	1290.	1291.	1369.	1370.	1495.	1496.	1503.	1514.	1580.	1581.	1582.
Insoluble Matter.....	3.82	1.42	.18		10.44	11.24	5.76	.19	2.13	3.45	3.55	
Pure Crystallized Gypsum ..	84.71	93.31	88.04	85.82	95.93	84.32	86.00	84.76	93.84	95.94	73.86	94.22
Moisture, Carbon dioxid, etc.	11.47	5.28	11.78		5.24	2.76	9.48	5.97	1.89	12.69	2.33	

Notes.

1289 and 1291. Huntington gypsum. A sample of average quality.

1290. Huntington gypsum. This is an extra quality of gypsum, and ranks well with the very finest found in the country.

1369 and 1370. Samples sent by Buell Lamberson, Portland. Said to be Japanese gypsum. The former was pulverized; the latter is of very high grade.

1495 and 1496. Samples of Ashpatu (Cal.) gypsum; the so-called "California gypsum" found in the Portland markets. The samples carry about the average amount of sulfate, but a larger amount of insoluble matter than is desirable. The former was of very dark color which is somewhat against it.

1504. Huntington gypsum of average quality, probably from same ledge as 1289.

1514. Huntington gypsum of superfine quality. It was from the interior of the ledge below 1504 and had a very fine crystalline structure much resembling granular sugar.

1580 and 1582. Huntington gypsum of excellent quality. The former was of a grey color; the latter very white.

1581. Huntington gypsum of low grade, about 10 per cent below the average quality.

Gypsum, or land plaster, has been used as a fertilizer from the time of the Greeks and Romans. Its action on soils as relates to plant growth has been the subject of exhaustive study by many experimenters, with the result of showing that its beneficial effects are not due to a direct fertilizing action but rather to indirect effects, and in this respect is not comparable with such fundamental plant foods as nitrates, phosphates and potash. Its most important function is its action on the double silicate of aluminum and potash.

an insoluble compound which exists in greater or less quantities in nearly all soils—especially in clays—converting them into a silicate of aluminum and lime, while the accompanying product, sulfate of potash, goes into solution and thus becomes available for plants. Thus the principal effect seems to be its power to set free potash from its insoluble compounds, making them available. Storer, an authority, says: "It is often of great use in regions where wheat is grown in alternation with clover, since by encouraging the growth of clover it acts as a manure for wheat."

On the soils of western Oregon it could be used to much advantage on account of the tendency of this soil to be weak in available potash. It would also serve to improve their physical condition by the particles thus making the soils more porous. In eastern Oregon it would be of high utility as a corrective for the hated black alkali. In western Oregon it should be sown in the very early spring at the rate of 100 to 150 pounds to the acre, preferably to encourage the growth of clover, the yield of which it not unfrequently increases fifty per cent. As a corrective for the black alkali in eastern Oregon it would have to be used in much larger quantities, probably not less than one ton per acre, this depending somewhat upon the amount of alkali present.

LIMESTONES.

Lab. No.	Locality	Insoluble Matter	Calcium oxid (Lime)	Iron and Alumina	Magnesia	Carbon dioxide, etc.
592	Near Baker City	.....	16.11	.....	11.06	.....
593	" "	.....	44.57	.....	9.44	.....
594	" "	.....	47.84	.....	.76	.....
595	" "	.....	52.59	.....	.98	.....
596	" "	.....	52.65	.....	.87	.....
948	Near LaGrande	9.81	50.43	1.58	.....	38.08
949	" "	trace	30.66	7.54	.....	.....
1296	Southern Oregon	8.93	48.68	trace	5.75	41.64
1297	" "	83.31	5.91	.00	3.32	7.46
1298	" "	2.79	23.30	19.78	2.79	61.34
1299	" "	4.98	47.01	.....	trace	48.01
1300	" "	5.49	54.24	1.08	.00	39.19
1528	Near Huntington	1.36	55.32	trace	1.37	41.95
1529	" "	.96	55.63	trace	.16	43.25
1530	" "	1.31	55.64	trace	.18	42.87
1531	" "	.90	53.50	trace	trace	46.55
1532	" "	18.94	32.10	3.45	15.62	30.89
1537	Near Baker City	1.43	31.30	.60	trace	.....
		4.00	53.42	.....	.....	42.58

Notes.

Samples 592-597, inclusive, were sent by Hon. W. P. Keady, of Portland. Nos. 595 and 596 are high grade samples and would make a fair rock for sugar work. or burn to an excellent lime. They have a purity of 93.85 and 93.95 per cent respectively.

Samples 948 and 949 were sent by Mr. E. W. Kammers, of La Grande, who desired only partial analyses. Samples are not of good grade.

Samples 1296-1310, inclusive, were sent by Mr. H. C. Perkins, of Grant's Pass, who desired particularly to know the magnesia content.

Samples 1528-1530 and 1550-1552, inclusive, are from different ledges near Huntington (Lime Spur). Nos. 1528 and 1529 are high grade blue limestones, and burn to an excellent white lime. No. 1550 is also a high grade rock from near the same ledge as 1528. These samples are of good quality for beet sugar work. No 1551 is a low grade lime rock, and would produce a dark and very inferior lime. No. 1552 is a "calcareous tuff," and would yield a very poor lime. The last two are worthless for sugar work.

A Dietary Study.

A writer recently stated that "although the cost of food makes so large a part of the whole cost of living, and although the health and strength of all are so intimately connected with and dependent upon their diet, yet even the most intelligent people know less of the actual uses and values of their food in fulfilling its purposes than of almost any other of the necessities of life."

The studies of dietaries so far made are not sufficient for reliable inference regarding the eating habits of the people at large. The total number is but a little over one hundred and these are confined mostly to New England. So far the results confirm the opinion of hygienists that our diet is one-sided in that we eat too much. It is one-sided in that we eat too little protein and too much fat, starch and sugar. There is also found to exist great waste in the purchase of food, and especially is this true among the classes who can least afford a waste, if such is allowable at all. This is not altogether due to kitchen waste since often it is due to the delusion that high priced articles are more nutritious than cheaper ones. A sirloin steak contains no more nutritive matter than a round and there is much more waste. It is also found that there is altogether too much carelessness in the kitchen in the saving of waste matter.

The following data were obtained from a dietary study conducted under the direction of the writer by a class in the "Chemistry of Foods" from the Household Science department of the college. The methods followed were those outlined by Prof. Atwater and explained in *Methods and Results of Investigations on the Chemistry and Economy of Foods* (Bul. No. 21, Office of Experiment Stations.) The general plan was to take an inventory of the amounts of all

material on hand at the time of beginning the experiment, to keep an accurate record of amounts of all material purchased during its progress, and at the end of the experiment to take another inventory of material on hand and to calculate the amount used from this data. Material used was assumed to have the average composition of American food material as published by Atwater.*

The kitchen waste and refuse, however, was brought to the laboratory from time to time, where they were prepared for and subjected to analysis according to the methods employed by Atwater and Woods, as published in the reports of the Storrs (Conn.) Experiment Station. The work was undertaken primarily to familiarize the class with methods of conducting such experiments in a study of dietaries. Inasmuch as the results are of interest at this time the data is here presented.

Cost of Food Used in Dietary Study.

In the following table is given as near as possible the usual cost of the materials used in this study when purchased in the Corvallis markets. The range of price is also given:

TABLE SHOWING USUAL PRICE OF FOODS USED IN DIETARY STUDY.

Food Materials.	Range in price.	Usual price.	Food Materials.	Range in price.	Usual price.
ANIMAL FOOD.			VEGETABLE FOOD.		
	Cents.	Cents		Cents.	Cents
Beef, shoulder.....per lb.	8 @ 10	8	Sugar, granulated.....per lb.	5½ @ 7	6½
Beef, steak, round....."	10	10	Cabbage....."	1 @ 1½	1½
Pork, bacon....."	7 @ 13	9	Celery.....per bunch.		5
Pork, lard....."	7 @ 10	10	Onions.....per lb.	1½ @ 2	2
Fish, smelt....."	4 @ 8	6	Potatoes.....per bu.	20 @ 35	25
Eggs.....per doz.	8 @ 30	15	Tomatoes, canned.....per qt.		10
Butter.....per lb.	15 @ 25	20	Apples.....per bu.	25 @ 40	25
Milk.....per qt.		5	Parsnips.....per lb.		1½
Sour milk....."		2	Honey....."		10
Buttermilk....."		2½	Canned strawberries.....per qt.		10
VEGETABLE FOOD.			Canned blackberries....."		10
Corn meal.....per lb.		2½	Canned prunes....."		10
Wheat flour....."	1¼ @ 2	2	Jelly, prune.....per ½ pt.		10
Graham flour....."		2	Preserves....."		10
Rice....."		7	Cocoa.....per lb.		30
Crackers, soda....."	8½ @ 10	10	Salsify....."		1

This study covered a period from Jan. 15 to Jan. 22, 1898, in a private family consisting of five members; two men, one 20 and the other 60 years of age; three women, aged 18, 25 and 45. All members of the family were in good health. The family was of the middle class and while in no sense penurious or close, yet has the reputation of "looking after the corners." One hundred and eighteen meals were eaten in the seven days—equivalent to one man 39½ days.

The tables giving the details of weights and percents from which the results given below are not published, inasmuch as they would not be of sufficient interest to people in general. The table given below gives the nutrients and fuel values of the food used, in the

* Bulletin 28, Office of Experiment Station.

table and kitchen wastes, and in the portion actually eaten. In estimating the fuel values of the nutritive ingredients the protein and carbohydrates are assumed to contain 4.1 and the fats 9.3 calories of potential energy per gram, which factors have been demonstrated to be practically correct.

NUTRIENTS AND POTENTIAL ENERGY IN FOOD PURCHASED, REJECTED AND EATEN.

Kinds of food material.	Cost.	Nutrients.			Fuel value.
		Protein.	Fat.	Carbohy- drates.	
		Grams.	Grams.	Grams.	Calories.
Food purchased:					
Animal	\$2.17	1,135	2,324	685	28,270
Vegetable	3.29	2,231	445	16,421	91,784
Total	5.46	3,366	2,769	17,106	120,054
Waste:					
Animal		12	18		166
Vegetable		30	46	234	1,421
Total		42	64	234	1,587
Food actually eaten:					
Animal		1,093	2,306	685	28,104
Vegetable		2,171	399	16,217	90,363
Total		3,264	2,705	16,902	118,467
PER MAN PER DAY.					
Food purchased:					
Animal	\$.07	36	75	22	909
Vegetable	.10½	71	14	528	2,951
Total	.17½	107	89	550	3,860
Waste:					
Animal		38	58		5.3
Vegetable		96	148	655	46.0
Total		134	206	655	51.3
Food actually eaten:					
Animal		35	74	22	903.6
Vegetable		70	13	521	2,905.2
Total		105	87	543	3,808.8
PERCENTAGES OF TOTAL FOOD PURCHASED.					
	Per cent	Per cent.	Per cent.	Per cent	Per cent.
Food purchased:					
Animal	39.7	33.4	83.9	4	23.6
Vegetable	63.3	66.6	16.1	96	76.4
Total	100.0	100.0	100.0	100	100.0
Waste:					
Animal		.36	.65		.14
Vegetable		.91	1.78	1.19	1.18
Total		1.27	2.43	1.19	1.32
Food actually eaten:					
Animal		33.1	83.2	4.0	23.41
Vegetable		65.7	14.3	94.8	75.27
Total		98.8	97.6	98.8	98.68

Notes.

Of the entire cost, \$5.46, for the seven days for the food for the family, which price takes account of everything eaten, whether purchased in the market or raised in the garden, reckoning the latter at market rates as per previous table, about 40 per cent was for animal food and 60 per cent for vegetable. A dietary experiment conducted in Connecticut showed an expense of 57 per cent of the total for animal food. About two-thirds of the protein was obtained from vegetable food; four-fifths of the fat came from animal food. Practically all the carbohydrates were obtained from vegetable food. Nearly two-thirds of the fuel value came from vegetable food. The total protein, or muscle-forming material purchased per man per day was 3.75 oz., fat 3.13 oz., carbohydrates 19.39 oz. Of this amount there was a waste of only 1.3 per cent in protein, 2.5 per cent in fat, and 1.2 per cent in carbohydrates, which is, indeed, remarkably small. There was no special attempt at saving during the time of this experiment, the family living as they ordinarily do. In this experiment the ratio of protein to fuel ingredients is as 1 to 5.9, which is about the same as the maximum of well nourished families in Europe. The average ratio in America is much wider than this. On this ration it cost per man per day seventeen and one-half cents.

NOTE.—For the routine work under "A Dietary Study" credit is due Misses Edna Groves, Hulda Holden, and Georgia Hartless, of the class of 1897.

5000.

Bulletin No. 63.

November, 1900.

Department of Bacteriology.

OREGON AGRICULTURAL EXPERIMENT STATION,

CORVALLIS, OREGON.

A PRELIMINARY BULLETIN

ON THE

PREVENTION OF SMUT ON OATS.

By E. F. PERNOT.

The Bulletins of this Station are sent Free to all Residents of Oregon who request them.

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A Preliminary Bulletin on the Prevention of Smut on Oats.

One of the most discouraging features of farming is the partial loss of a crop through agencies which can not be detected or remedied after it has begun growing. A field of oats, which promises such good returns just before heading, frequently turn out to be a failure at the time of harvesting. The oat head which should contain the plump, nutritious kernel, is but a withered husk, filled with a noxious black powder, which are the spores of a parasitic fungus, (*Ustilago Avenæ*.) These spores are carried in a great many different ways to kernels of oats which are subsequently used for seed-ing. When such oats are planted, the fungus spores germinate at the same time as the oats and the mycelium enters the young sprout from which it derives its nourishment. It is unnecessary here, to go into the detail or life history of this parasitic fungus, let it suffice to state that it is not a contagious disease transmitted from plant to plant, but one which is produced by spores which are present on the seed grain, or in the soil, at the time of sowing. When they occur only in the seed oats, they may readily be destroyed, but when they are in the soil, other crops should be grown to eradicate them, as treatment of the soil is impracticable.

Many methods have been tried for the purpose of killing the spores which are attached to the seed oats and while some have been found good, others are almost worthless.

An experiment in testing the best and simplest method of sterilizing seed oats, to destroy smut spores, was conducted this year. Seed which was known to produce smutted oats, was treated in the following manner and sown in experimental plats.

The seed sown in plat A was dipped for ten minutes into a solution of copper sulfate in the proportion of two ounces to the gallon of water.

Plat B. The seed was soaked in a solution of zinc sulfate, two ounces to one gallon of water for ten minutes.

Plat C. The seed was soaked in a solution of copper sulfate, four ounces to one gallon of water for ten minutes.

Plat D. The seed was soaked in a solution of zinc sulfate, four ounces to one gallon of water for ten minutes.

Plat E. The seed was soaked in water at a temperature of 132° F. for ten minutes.

Plat F. The seed was soaked in a solution of formalin, one part to ten thousand parts of water for ten minutes.

Plat G. The seed was soaked in a solution of formalin, one part to five thousand parts of water for ten minutes.

Plat H. The seed was heated in a hot air sterilizer at a temperature of 200° F. for ten minutes.

On the 21st of July all the oat heads which showed any signs of smut were carefully removed and counted, with the following results:

Plat A contained 14 heads affected with smut.

Plat B contained 46 heads affected with smut.

Plat C contained 64 heads affected with smut.

Plat D contained 77 heads affected with smut.

Plat E contained 0 heads affected with smut.

Plat F contained 274 heads affected with smut.

Plat G contained 244 heads affected with smut.

Plat H contained 1 head affected with smut.

One hundred kernels from each sample of oats treated were tested for their germinating qualities with the following results:

Sample A germinated 100%. Sample E germinated 92%.

Sample B germinated 100%. Sample F germinated 100%.

Sample C germinated 89%. Sample G germinated 100%.

Sample D germinated 100%. Sample H germinated 90%.

Sample I germinated 95%, not treated.

In order to determine the effects of different temperatures on the germinating qualities of the oats, one thousand grains divided into 10 lots of one hundred each, were heated at different temperatures, and germinated with the results as seen in the following table:

SAMPLE I.

One hundred grains dipped in water at 132° F. for ten minutes. Placed in germinating pans May 12th, 3 P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9 o'clock a. m.	5
16	9 o'clock a. m.	24
16	3.30 o'clock p. m.	9
17	9 o'clock a. m.	20
17	3.30 o'clock p. m.	4
18	9 o'clock a. m.	8
18	3.30 o'clock p. m.	3
19	9.00 o'clock a. m.	5
19	3.30 o'clock p. m.	0
20	9.00 o'clock a. m.	0
20	3.30 o'clock p. m.	2
Total number germinated		80

SAMPLE II.

One hundred grains heated to 132° F. for ten minutes. Placed in germinating pans, May 12th, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9.00 o'clock a. m.	15
16	9.00 o'clock a. m.	38
16	3.30 o'clock p. m.	8
17	9.00 o'clock a. m.	21
17	3.30 o'clock p. m.	3
18	9.00 o'clock a. m.	8
18	3.30 o'clock p. m.	0
19	9.00 o'clock a. m.	0
19	3.30 o'clock p. m.	0
20	9.00 o'clock a. m.	0
20	3.30 o'clock p. m.	1
Total number germinated		94

SAMPLE III.

One hundred grains heated to 140° F. for ten minutes. Placed in germinating pans, May 12th, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9.00 o'clock a. m.	7
16	9.00 o'clock a. m.	36
16	3.30 o'clock p. m.	16
17	9.00 o'clock a. m.	32
17	3.30 o'clock p. m.	2
18	9.00 o'clock a. m.	5
Total number germinated		98

SAMPLE IV.

One hundred grains heated to 150° F. for ten minutes. Placed in germinating pans, May 12th, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9.00 o'clock a. m.	27
16	9.00 o'clock a. m.	43
16	3.30 o'clock p. m.	13
17	9.00 o'clock a. m.	14
17	3.30 o'clock p. m.	0
18	9.00 o'clock a. m.	3
Total number germinated		100

SAMPLE V.

One hundred grains heated to 160° F. for ten minutes. Placed in germinating pans, May 12th, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9.00 o'clock a. m.	16
16	9.00 o'clock a. m.	32
16	3.30 o'clock p. m.	13
17	9.00 o'clock a. m.	33
17	3.30 o'clock p. m.	3
18	9.00 o'clock a. m.	3
Total number germinated		100

SAMPLE VI.

One hundred grains heated to 170° F. for ten minutes. Placed in germinating pans, May 12th, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9.00 o'clock a. m.	3
16	9.00 o'clock a. m.	28
16	3.30 o'clock p. m.	12
17	9.00 o'clock a. m.	32
17	3.30 o'clock p. m.	9
18	9.00 o'clock a. m.	12
18	3.30 o'clock p. m.	2
Total number germinated		98

SAMPLE VII.

One hundred grains heated to 180° F. for ten minutes. Placed in germinating pans, May 12th, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9.00 o'clock a. m.	0
16	9.00 o'clock a. m.	2
16	3.30 o'clock p. m.	0
17	9.00 o'clock a. m.	25
17	3.30 o'clock p. m.	6
18	9.00 o'clock a. m.	28
18	3.30 o'clock p. m.	7
19	9.00 o'clock a. m.	16
19	3.30 o'clock p. m.	0
20	9.00 o'clock a. m.	5
20	3.30 o'clock p. m.	0
21	9.00 o'clock a. m.	3
Total number germinated		92

SAMPLE VIII.

One hundred grains heated to 190° F. for ten minutes. Placed in germinating pans, May 12th, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9.00 o'clock a. m.	0
16	9.00 o'clock a. m.	1
16	3.30 o'clock p. m.	0
17	9.00 o'clock a. m.	8
17	3.30 o'clock p. m.	7
18	9.00 o'clock a. m.	28
18	3.30 o'clock p. m.	8
19	9.00 o'clock a. m.	37
19	3.30 o'clock p. m.	5
20	9.00 o'clock a. m.	5
20	3.30 o'clock p. m.	0
Total number germinated		99

SAMPLE IX.

One hundred grains heated to 200° F. for ten minutes. Placed in germinating pans, May 12, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9.00 o'clock a. m.	0
16	9.00 o'clock a. m.	0
16	3.30 o'clock p. m.	0
17	9.00 o'clock a. m.	0
17	3.30 o'clock p. m.	4
18	9.00 o'clock a. m.	31
18	3.30 o'clock p. m.	9
19	9.00 o'clock a. m.	30
19	3.30 o'clock p. m.	5
20	9.00 o'clock a. m.	11
Total number germinated		90

SAMPLE X.

One hundred grains not treated. Placed in germinating pans, May 12, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9.00 o'clock a. m.	59
16	9.00 o'clock a. m.	33
16	3.30 o'clock p. m.	8
Total number germinated		100

This germinating test, although made on a small scale, would indicate that the hot air process admits of a wide range without injuring the germinating quality of the seed.

The treatment of seed oats for smut with sulfate of copper, sulfate of zinc, formaldehyde, and hot water, have long been known and practiced, but there is a serious drawback in using a treatment which requires a liquid, for several reasons.

First. The oat kernel is enclosed in a husk, and beneath this husk it is covered with small hairs. Either one or both of these prevents the liquid from coming in contact with the minute spores of the fungus, which may be lodged among the hairs, or beneath the husks, so that there are more or less spores which escape being destroyed.

Second. Oats which are dipped into a solution are difficult to dry, especially in rainy or damp weather, and they are liable to germinate or become mouldy before being sown.

Third. It requires a large floor space to dry them and considerable time and apparatus to perform the operation of dipping successfully, especially in the hot water treatment, where barrels, kettles, thermometers, furnaces, and other appliances are needed.

The hot water method, if properly performed, is very effective, but if improperly or carelessly done there is danger of simply attenuating the spores instead of destroying them. The water in this method is simply a vehicle to convey heat, it has no other virtue, so in order to obviate the necessity of so much apparatus and trouble in drying the seed, one sample was treated with hot air in a laboratory hot air sterilizer. The temperature was raised to 200° F. and maintained for ten minutes; although this temperature was too high, the table shows that sample H germinated 90% of the seed. The plat sown with this seed contained only one head of smut, which may have come from one kernel of accidentally untreated seed. In the Willamette valley there are many hop and fruit dryers, which could be used for treating seed grain by this hot air method, with good advantage and at a slight cost. The seed could be treated at any time and stored until seeding season, but it must be remembered that seed which is treated for smut, should not be returned to the sacks again without their having been treated in like manner, because the meshes of the fabric offer an excellent place for spores to lodge, so that if the sacks were not treated, reinfection of the grain would occur.

In treating the oats, they should be spread in thin layers on the dryer trays, in order that all may receive the same exposure to the heat. If they were placed in the heater in sacks full, those in the center would receive little or no heating; or, if they were placed in the heater in large piles, it would be necessary to stir them continually, as in roasting coffee or peanuts, in order that they receive equal exposure to the heat.

It is a well recognized fact in all bacteriological work that there is nothing known to be more efficient in destroying germs and spores than dry heat, so that the advantages of the hot air methods are:

First. That it completely destroys spores.

Second. That it penetrates to all parts of the grain.

Third. That the seed is ready for sowing immediately after treatment.

Fourth. That there is no danger of injuring the seed through germination, mould, or decay, as in the wet method.

Next year an extensive experiment with different seed grains will be conducted to test more fully the virtue of hot air as a preventive of smut.

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Department of Bacteriology.

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CORVALLIS, OREGON.

Investigation of Diseases in Poultry.

By E. F. PERNOT.

**The Bulletins of this Station are sent Free to all Residents of
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PLATE I.

Investigation of Diseases in Poultry.

The poultry industry in the state of Oregon, although apparently insignificant, is equal if not greater in importance to that of wheat raising.

It is difficult to estimate the immense amount of money annually distributed among poultry raisers and farmers because it is divided into such numerous small amounts. Eggs and poultry play such an important part in providing fresh meat and groceries for the farmers, that the barnyard fowls are indispensable. On the other hand, those who are engaged in raising poultry for the market, by modern methods, find it to be remunerative and within the reach of even those possessing but small capital. The success of such enterprises depends largely upon the intelligent management of the fowls when disease manifests itself among them. The lack of proper understanding as to what should be done when mortality occurs among incubator chicks, has discouraged a great many who might otherwise have made a success of the enterprise.

Some of the conditions found in western Oregon during the past year are described in the following pages, in a popular form, in the hope that they may be of some benefit to poultry raisers.

AVIAN TUBERCULOSIS.

Avian tuberculosis is a contagious disease, caused by the presence of the tubercle bacilli, which is to fowl as tuberculosis (consumption) is to man, or animals. The germs, while growing in the body of the fowl, appear to be identical with those in mammals with the exception of their being a trifle larger and more vigorous, but when artificially grown in bouillon, or glycerine agar, at a high temperature, their morphology differs materially from the others.

The pathogenesis of this germ to animals has not been satisfactorily demonstrated. My experiments of inoculating guinea pigs with different quantities of the fresh tubercles, taken from the intestines and liver of a hen and macerated with a small quantity of bouillon, have given negative results. This test was by no means satisfactory or conclusive on account of the impossibility to obtain a sufficient number of lower animals at a time when they were needed, and no positive conclusion can be deducted from inoculating such a small number, especially as guinea pigs are slightly, if at all, susceptible to the disease.

The first outbreak cited was that of a hen sent to the station from a flock in which six hens had already died of the same disease. In order to study the symptoms, the bird was kept three days, until its death. The day before its death it was photographed, and presented the appearance as seen in Plate 1, being very much emaciated.

Although the hen was a graded Plymouth Rock which would in normal health weigh about four pounds, it was reduced to only twenty-two ounces.



Fig. 1.

PLATE II.

Fig. 2.

At the post mortem examination the bird was found to have generalized avian tuberculosis, the digestive tract being the original seat of the disease; this was evident by the extreme growth of the tubercles on the intestines (see Plate II, Fig. I). The mesentery was a net work of tubercles presenting the appearance of

bead work. The liver was an infiltrated mass of yellowish colored tubercles so closely packed together that they enlarged that organ four times its normal size. See Plate II, Fig. 2, in which a portion of the liver is shown. The enlarged liver, together with the tubercles on the intestines, completely filled the abdominal cavity; the spleen contained a great many small tubercles; the heart had one tubercle, about the size of a wheat kernel, on the right auricle. The lungs were affected in one spot only, and that at a point where the liver came in contact with them. Nearly all over the body the connective tissue between the skin and the flesh, contained tubercles about the size of millet seed. No external growths were found on the legs, wings, head, or any other part of the body.

The first noticeable symptom of this disease is, generally, lameness; the bird becomes more or less mopy, and gradually loses flesh until at the time of death it is a mere framework with feathers.

The appetite is good throughout its sickness, at times it even becomes ravenous for food, and although it eats heartily this does not seem to appease the hunger.

Toward the latter stages of the disease there is nearly always a persistent diarrhoea and the evacuations are accompanied by a discharge of a white or yellowish viscid matter. In all the specimens received, this matter was carefully examined and in each case the tubercle bacilli were found in countless numbers.

When the tubercle on the intestine reaches a certain period of its growth, there is a breaking down of the intestinal wall, and the germs are passed out with the fæces, thus accounting for the rapid transmission of the germs from fowl to fowl, for in nine cases out of ten, the chickens' food is contaminated with their excrement.

To illustrate the danger of spreading this disease, the writer was called to visit a farm where it was found that fifty chickens had died of tuberculosis. In order to call the chickens together for our inspection, the owner scattered a handful of wheat on the ground of a run, where six choice blooded fowls had died some time previous; some of the wheat fell on the fresh excrement, and upon picking up several kernels with forceps, the under side of each was found to be soiled, but a chicken would not hesitate picking it up and swallowing. So if there were one sick bird passing germs, it would be only a matter of time that all would become infected. This offered an excellent opportunity to point out the danger of feeding in this manner.

There is still another dangerous and bad practice in vogue, that of leaving the carcasses of diseased fowls to decay or to be eaten by the hogs or chickens. *They should by all means be buried deeply or burned*; it will pay any poultry raiser to do this.

We are as far from solving the problem of a remedy for this disease as we are from curing consumption in man, therefore nothing can be said yet, except to urge the necessity of sanitary precautions, and the early removal and destruction of sick fowls from the flock, as well as thorough disinfection of the premises.

During the past year there were six outbreaks of avian tuberculosis discovered, ranging in a loss of from five to fifty chickens in a flock. The lesions were all practically the same as those already described, with the exception of one case, in which the hen had a tuberculous leg, as illustrated in Plate III.

The hen's leg in this case had evidently been inoculated with the tubercle bacilli by picking it with an infected beak at that point,



PLATE III.

or from some other external injury. Several hens from the same flock had previously died from generalized tuberculosis. Microscopical examinations were made from time to time of the exudate from this hen's leg and the bacilli were always present. A hen in this condition should certainly be removed from the flock and destroyed to prevent further infection.

Reports show that the fatality amongst grown chickens, especially older ones, is greater from this disease than from any other.

There appears to be no record of the transmission of these germs from fowl to man, with fatal results, although the possibility may exist. The flesh of a fowl in an advanced stage of avian tuberculosis can not be wholesome as an article of food and should not be eaten.

CATARRH AND CATARRHAL ROUP. .

There have been a great many specimens of chickens and turkeys sent to the station this year which were suffering from catarrh and catarrhal roup. This trouble seemed to have prevailed in many localities, with more or less fatal results. Among the young chickens it became epidemic, destroying an immense number. Experiments to find a remedy for this trouble were conducted with the specimens received, and the following has proven eminently successful:

A two per cent solution of permanganate of potash in water, or two ounces of permanganate to six and one-half pints of water, was used. The fowl is grasped by the body with one hand and by the neck with the other; the head is then plunged into this solution completely submerging it, and held there until the bird is nearly choked, then removed to allow it to breathe, this will cause it to sneeze, and in so doing, force the solution through the air passages, thus reaching the affected parts. Repeat this operation three times while the bird is still in hand, and at least twice a day, so long as there are any evidences of the disease left. Care should be taken not to strangle the bird by holding its head under the solution too long, and, on the other hand, if not held long enough, the solution will not reach the desired parts. If an incrustation or scab has formed over the nostrils it should be carefully removed by moistening with warm water and with the aid of a toothpick—this must be done before immersing the head in the solution.

The next step is to take a part of the solution, dilute it with four times its bulk of water, and give it to the fowls to drink. They should have nothing else but this to drink for three or four days, keeping it fresh each day. If the trouble reappears repeat the operation of dipping the head until a cure is permanently effected. A chicken or a turkey that is worth anything is worth this trouble to cure.

FAVUS.

One outbreak of favus was found during the past year. It is commonly known as "baldness" or "white comb," and is caused by a fungus named the *Achorion Schonleinii*. In mankind the disease is known as *tinea favosa*, or favus.

Favus is a disease of the skin which first manifests itself by small white or grayish spots on, or near, the comb. The spot is very small at first, gradually becoming larger until the whole surface is covered with a scaly crust. The feathers become dry, ruffled, and eventually fall off, leaving the skin bare, from whence it derives the popular name "baldness." It is a contagious disease which is transmitted from bird to bird, and whenever an abrasion of the skin receives the spores the fungus develops very rapidly. It is not fully known just how the fungus spreads all over the head and neck of the fowl unless it is by the rubbing of one part of the body against another, or by scratching. Artificially grown on slant nutrient agar the colonies remain isolated until they grow sufficiently large to touch

each other and form a white scab along the line of inoculation, but when a spore is accidentally deposited near the edge of the test tube, the colony developed from it remains isolated throughout its existence. If there be too much condensation water in the tube, the whole surface of the slant will become covered, especially if the tube is handled after being inoculated.

A wise precaution in the treatment of skin diseases in fowls is to remove the bird for that purpose. For instance, in the treatment of favus, if the scales are rubbed off and allowed to drop on the floor of the coop or their runs, other fowls will become infected, because the scales contain innumerable spores. Any scales removed from an affected bird should be burned, for "an ounce of prevention is worth a pound of cure."

In the treatment of this disease it must be borne in mind that we are dealing with a fungus whose mycelium penetrates beneath

the surface of the epidermis where external applications cannot reach without some preliminary treatment to remove the crusts which should be accomplished by the aid of some blunt instrument, or by such means as would remove dandruff from the head, care being taken not to cause an abrasion of the skin; then apply an ointment made from vaseline and two per cent carbolic acid, which may be bought ready prepared at almost any drug store. Carbolic acid one part, soft soap twenty parts, well mixed, has been recommended.



PLATE IV.

SCABIES.

Plate IV is from a photograph taken of the leg of a hen afflicted with "scabies" or "scaly legs," and is introduced here to illustrate the difference between scabies

and tuberculosis of the legs. Scabies is caused by the presence of a mite known as *Sarcoptes Mutans* which penetrates beneath the epidermic scales. Dr. Salmon writes, that by burrowing, these mites set up an irritation which leads to a multiplication of the cells of the part and an exudation of serum. It is by the union of these

two conditions that the white powdery crusts are formed, which raises the epidermic scales from their normal position. If the crusts are removed and the under surface examined with a lens, they are found to contain a large number of depressions, in each of which a female egg, containing sarcopt, is lodged. The larvæ, males, and younger females are found wandering beneath the crust. The latter contains so many cavities that it has very much the appearance of dried bread. As the crust thickens by deposits on the inner surface, the cavities first formed become smaller by the drying of the walls surrounding them, and the sarcopt abandons this location for a position nearer the flesh, where there is more moisture. The mites are therefore found only on the inner surface of the crust although the cavities, or honey combed appearance, exist throughout the whole substance. The treatment, briefly stated, is to remove the affected birds to prevent the spread of the contagion. The houses they occupy should be thoroughly cleaned, the roosts and other woodwork should be scalded with boiling water, or covered with carbolated lime wash.

The treatment of the afflicted birds is to remove the loosened scales in order to bring the remedy in contact with the mites. To accomplish this, the legs should be soaked for a sufficient time in warm water to which some soap has been added. When thoroughly softened, the loose scales may be removed without causing the leg to bleed. After this has been done the legs are dried and treated with a good coat of ointment made with balsam of Peru, one or two drachms to one ounce of vaseline. The disease is not a difficult one to cure if the preliminary treatment is thorough and the loose scales and crusts are all removed. There are cases of tuberculosis, however, which affect the birds' legs by forming an external growth which very much resembles scaly legs, but by treating as above described, the diseases may readily be differentiated. The crusts in scaly leg are easily removed, while in tuberculosis it is impossible to do so.

LUNG DISEASES.

During the spring months the writer was called to examine many broods of incubator chicks which were dying in great numbers, and there were also many specimens sent through the mails to the station for examination from different parts of the state. In all the specimens examined there were but three troubles found, one was pneumonia, another congestion of the lungs, and the third will be mentioned

later on. The two former were the results of the little chicks' having become chilled.

There is but one step between the two diseases, and the environments which are responsible for the chick's taking cold and producing a congestion of the lungs, are factors in conjunction with the pneumococcus in producing pneumonia.

For the benefit of the Oregon poultry raisers who desire to examine their diseased fowls suspected of having pneumonia or congestion of the lungs, a few plain directions may be serviceable.

In congestion of the lungs the chick, after being chilled, becomes mopy and stupid, the respiration is rapid and difficult. It "looks cold," and if possible will attempt to gather warmth from a ray of sunshine which may find its way into the brooder house. The symptoms appear quickly, and the disease runs its course in a short time.

Upon examination the lungs are found to be very dark in color and filled with blood. If a blood vessel has been ruptured the bronchi and air sacs will be filled, a thick mucous will likely be found in the windpipe and mouth, and suffocation is the cause of death. In pneumonia the symptoms are similar to those described in congestion of the lungs, the discharge from the mouth or nostrils may be colored with blood or have the color of prune juice; the bird becomes mopy, with head drawn in, drooping wings, and ruffled feathers. The appetite is poor but thirst increases.

The lung, or lungs, after death are found to have a dark color and are solidified, owing to the engorgement of an exudate. If a portion of the lung were dropped into water it would sink, whereas the healthy lung tissue would float. This form of pneumonia is known as croupous pneumonia. There is another form known as broncho-pneumonia, in which the bronchial tubes are affected with inflammation and the lung does not become so solidified.

The pneumococcus, the germ which is conceded to be the cause of pneumonia and which is so closely associated with it, is also found in the mouth during health, awaiting a favorable opportunity to develop. When a bird becomes chilled from exposure or draughts, dampness, or sudden changes of temperature, the blood is forced from the surface of the body into the lungs and other organs, the circulation is checked and congestion follows.

Such a condition of the lungs, aided by the germ, no doubt changes congestion into inflammation, and the blood vessels throw

out a liquid which coagulates after filling the air cells, thus accounting for the firmness and solidity of the lungs in croupous pneumonia. Some of the brooders and brooding houses in use are altogether wrong for this climate where there is such a great difference in temperature between night and day, especially in the humid spring months.

Some of the brooder houses visited were constructed of rough lumber; they were cold and draughty, and were but mere shells without ceilings or means of maintaining an even temperature. The brooders were placed on the floor and heated with kerosene lamps which continually gave off irritating fumes; some were heated from above and others from below. The continued breathing of these vapors, gases, or impure air, depletes the system of the young chick, making it more susceptible to taking cold. There were large numbers of chicks in each brooder and in the early part of the night they would huddle closely together, raising the temperature by the radiation from their bodies; those in the center of the group, although too warm, were compelled to remain where they were and breathe that foul smoky air all night long. Early in the morning they would emerge from their stifling sweat-box into the run in search of food where they would stand and peep in an atmosphere thirty degrees, or more, colder than their brooder. The result was that they became thoroughly chilled before their attendant arrived, and died by the hundreds from the colds which they contracted.

Unless some means are found to maintain an even temperature during the night and day in the brooder house, and dispense with the foul oil lamps in the brooder, chicken raising with the incubator will not be a success in this section during the early spring months.

A very ingenious device, in use by a young lady in Salem, as a substitute for the oil-heated brooder was found and is worthy of mention here. It consisted of a square wooden box or frame, with sides about six inches high. Across the top of this frame were arranged laths at intervals of one inch; from these laths were suspended strips of woollen goods about the width of carpet rags, tacked closely together, and reaching nearly to the floor of the frame. A cover provided with holes for ventilation was placed a few inches above the slats, and the whole structure was covered with an awning similar to a tent. The temperature was maintained at night with a lamp situated outside, from which pipes conveyed the heat to the enclosure. An opening at one end of the frame, protected with cloth strips, communicated with the run outside.

The advantage of such a device is, that it prevents the chicks from huddling too closely together and becoming overheated, the strips keeping them separated and there is perfect ventilation. The radiated heat from their bodies is retained by the strips of wool. The laths, with strips attached, may be removed at any time and scalded to prevent lice or germs from accumulating.

Devices of this kind, placed in evenly heated brooder houses, would be worth more than all the remedies known for incubator chicks, because it would be removing the cause of the disease.

Ninety-nine per cent of the chicks were raised in this manner, while those raised by the ordinary brooder, in the same neighborhood, did not average sixty per cent.

To be successful with them, the strictest sanitary precautions must be observed to prevent contagious and infectious diseases among fowls. Even then, germ diseases will occasionally manifest themselves from unknown sources, but they are much easier controlled when they attack robust, healthy fowls in cleanly premises.

Great care should be taken not to allow any other than perfectly healthy fowls to enter fairs, nor any place where they are collected for exhibition. It seems needless to add that children should be forbidden to handle or to be with diseased fowls, especially those affected with diphtheria or diphtheretic roup, as these diseases are transmissible to human beings.

The treatment for lung disease in fowls is very unsatisfactory because the seat of the disease is inaccessible, and its progress so rapid that but little can be done to check it. In the event of a valuable bird being affected, it is well to remove it to a warm room, and administer a soothing drink, such as linseed tea. One grain of nitrate of potash dissolved in the drink and administered three times a day has been highly recommended. Too much cannot be said in urging the necessity of keeping the delicate chicks from taking cold. They are poorly clad, especially along the back under which the lungs are situated, and the small amount of food which they take before going to roost for the long night is insufficient fuel to maintain the body heat until they are fed again in the morning; hence the necessity of providing a brooder house that will be as warm in the frosty morning as it was the evening before. Not too much heat, and good ventilation, without draughts, are also very essential points.

5000.

Bulletin No. 65.

January, 1901.

DAIRY DEPARTMENT.

OREGON AGRICULTURAL EXPERIMENT STATION,

CORVALLIS, OREGON.

CREAMERIES AND CHEESE FACTORIES OF WESTERN OREGON.

By F. L. KENT.

The Bulletins of this Station are sent Free to all Residents of
Oregon who request them.

Oregon Agricultural College Printing Office.
GEO. B. KEADY, Printer.
1901.

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Introductory.

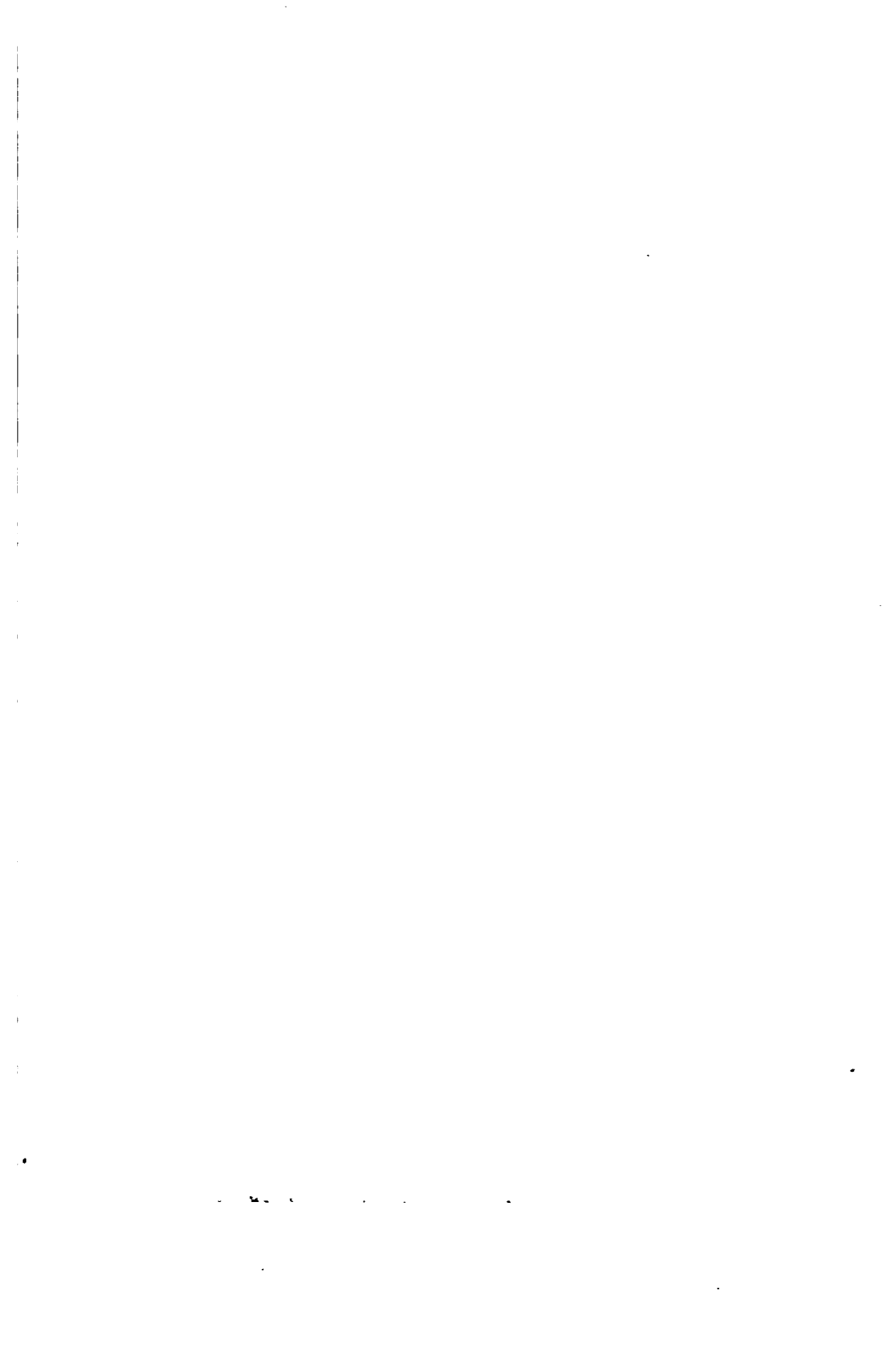
In the absence of accurate information regarding the extent of the butter and cheese industry in the state of Oregon, the writer decided to make a tour of investigation among the creameries and cheese factories of the western portion of the state, for the purpose of gathering general information regarding the industry, and particular information regarding the amount of butter and cheese made during the year 1899. Accordingly the greater portion of the months of July and August of the past summer was spent among the butter and cheese factories of the western portion of the state. Owing to the small number of factories in the eastern part of the state and the limited time at the writer's disposal, no attempt was made to visit the factories in that region.

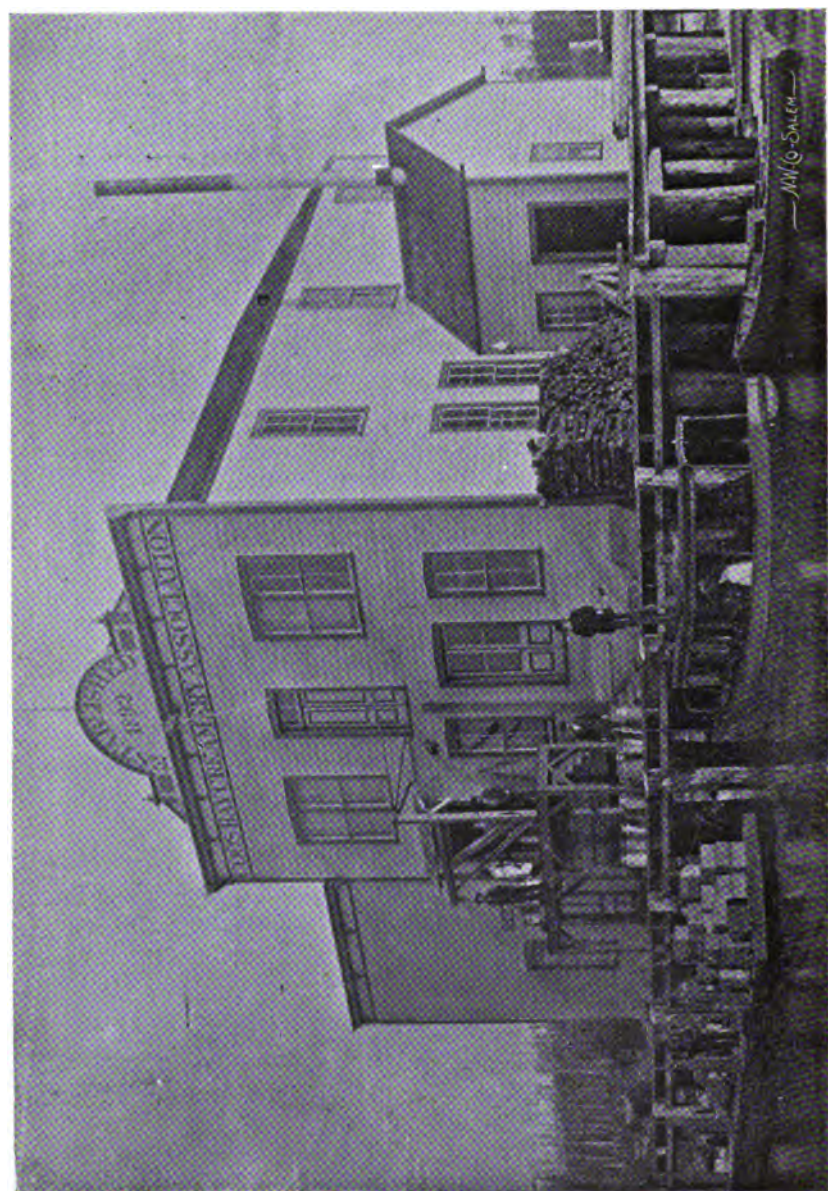
The topography and climatic conditions naturally divide the state into two parts, separated by the Cascade range of mountains, which are commonly spoken of as "Eastern Oregon" and "Western Oregon." While the creameries and cheese factories in eastern Oregon are as yet very few in number, this section of the state is believed to have great possibilities as a dairy region, particularly in the northern portion. Indeed, parties familiar with dairying in southern Minnesota are of the opinion that this section of Oregon will eventually rival equal portions of southern Minnesota and northern Iowa in the quantity and quality of its dairy productions. During the fall of 1900 the most up-to-date creamery in the state was established at the town of Milton, which is situated in the locality under discussion. At least, such is the opinion of a recognized authority who, after a visit to and a careful inspection of this creamery, pronounced it the best equipped creamery he had ever seen. This establishment is conducted on the co-operative plan, this method of operation being decided upon after a careful investigation of creamery methods in the state of Minnesota by a committee of citizens of Milton and vicinity. This creamery is said to be equipped with the latest and best appliances known to the creamery supply trade, and as it is conveniently located on the line of the Oregon Railway and Navigation Co., it should prove a valuable object lesson to future creamery building in the northern portion of eastern Oregon.

The western portion of the state is commonly spoken of as the "Willamette Valley," "Southern Oregon," and the "Coast Regions," the latter being very important in a consideration of the dairy industry. While the whole of western Oregon has a greater rainfall and milder climate than the eastern portion of the state, the topography of the western portion warrants the divisions just mentioned. The Coast Range, running practically parallel to the Pacific Ocean and the Cascade Mountains, makes a rather formidable barrier between the coast regions and the Willamette valley which greatly interferes with transportation between these two sections. A transverse range of low mountains known as the Calipooias, makes a rather distinct division between the Willamette valley and southern Oregon. These two latter named regions, however, are connected by the Southern Pacific railroad.

A person unfamiliar with the topography of a mountainous region would scarcely realize the amount of territory covered by the foothills of a mountain chain like the Coast Range. It is safe to say that a strip of country averaging thirty miles in width and extending clear across the state from north to south is occupied by this range of mountains and its foothills. On the western side of the Coast Range these hills are usually covered either with a dense growth of timber, generally fir, or with a luxuriant growth of fern. And it is reported that where the fern has been killed and cultivated grasses such as clovers introduced, they have made their way clear to the summit of these hills, and the prediction has been made that in the future this region may be not unlike picturesque and practical Switzerland from a dairy standpoint.

The factory system of making butter and cheese in this state is practically a development of the past ten years. To the best of the writer's knowledge there is but one butter factory in the state now in operation constructed prior to the year 1892. In fact the development in the U. S. has been wholly within the last half of the present century. It is generally conceded that the credit of establishing the first real cheese factory, which served as a model and incentive to others, belongs to Jesse Williams of Rome, Oneida, county, N. Y. Mr. Williams, was an experienced and skilful cheesemaker, and in 1851 began working up the milk of some of his neighbors in addition to his own. He was so successful that the next year a special building was erected and fitted up with the best apparatus obtainable. In 1869 the number in the whole county ex-





ceded 1000 and from that time on the factory system practically superceded the making of cheese on farms. Making butter in quantity from milk or cream collected from numerous farms soon followed. Such establishments are properly butter factories, but the name of "creamery" has been generally adopted and is not likely to be changed. The first creamery was built by Alanson Slaughter, near Wallkill, Orange county, N. Y., in the year 1861. The milk from 375 cows was received here daily. The earliest creameries received the whole milk from the farms, and set it in immense shallow pans. A little later the milk was set in "shot gun" cans, about 8 inches in diameter and 20 inches deep. These cans were then set in pools of cold water for the cream to rise. About 1875 the "gathered cream" system was introduced, the milk being set and skimmed on the farms where produced and the cream only sent to the factory. The centrifugal cream separator was perfected in the year 1879, and in the early 80's was introduced into this country, soon becoming quite generally used, and largely supplanting the gathered cream system.

Within the past ten years the "hand" or "farm" separator has been gradually coming into use and in the near future will cause a return, in many localities, to the gathered cream system.

FACTORIES VISITED.

There is a tendency on the part of many people to consider as creamery butter all butter made from cream separated from milk by means of a centrifugal cream separator, but this is not the proper meaning of the term "creamery butter." The National Creamery Buttermakers' Association requires that all butter entered for premiums at the annual meetings of the association shall be made from milk furnished the factory by not less than twenty patrons. The Oregon State Board of Agriculture, in providing for premiums at the state fair, says in its rules and regulations: "Creamery butter shall consist of butter made in the factory from milk of cows kept on two or more farms by two or more individuals, and where milk is purchased, or delivered on the co-operative plan." Bearing in mind these regulations, the writer did not make an effort to visit many of those places where it was known that only the milk of the owner's cows was handled, and such of these places as were visited do not appear in the following table of creameries and cheese factories, arranged alphabetically by counties:

Western Oregon Creameries and Cheese Factories.

Name of Creamery or Cheese Factory.	Located at or near	When built.	Form of Organization.	Name of Owner or Manager.	Name of Operator.	Value of Plant	No. of Patrons.	Kind of Product.
Benton County—								
Corvallis Creamery	Corvallis	1897 Prop.	1897 Prop.	Geo. Taylor	Geo. Taylor	\$ 4000	25	Butter.
Jersey Creamery	"	1899 Prop.	1899 Prop.	M. S. Woodcock	Hubler	1100	3	Butter and cheese.
Oregon Agricultural College	"	1893 State	1893 State	Agricultural College	F. L. Kent	1100	3	Butter and cheese.
Clatsop County—								
White Clover Creamery	Astoria	1899 Prop.	1899 Prop.	T. S. Townsend	Ad Skyles	2150	40	Butter.
Clatsop Dairy Association	Clatsop	1896 Co-Op.	1896 Co-Op.	Josiah West	W. H. Nichols	1300	4	Butter and cheese.
Clackamas County—								
Logan Cheese Factory	Logan	May, 1900 Stock	1900 Stock	W. W. Austen	A. H. Olmsted	1500	26	Cheese.
Damascus Creamery	Damascus	1894 Prop.	1894 Prop.	Vetsch Bros.	A. Vetsch	1200	5	Butter.
Columbia County—								
Oak Grove	Scappoose	1893 Prop.	1893 Prop.	Chas. Heggle	G. A. Heggle	2500	26	Butter.
Jackson Creek	"	Mar., 1899 Prop.	1899 Prop.	J. C. Johnson	C. J. Lamberson	2000	25	Butter and cheese.
Coos County—								
Bessey Creamery	Marshfield	1894 Prop.	1894 Prop.	E. L. Bessey	E. L. Bessey	1000	5	Butter.
Coos Bay Creamery	"	1892 Co-Op.	1892 Co-Op.	H. E. Bessey	J. N. Stenback	9000	60	Butter and cheese.
*Arago Creamery	Arago	1892 Prop.	1892 Prop.	Burgess & Schroeder	W. M. Burgess	7000	25	Butter.
Magnolia Creamery	Coquille	1896 Prop.	1896 Prop.	Schroeder & Sons	C. A. Schroeder	1200	2	Butter.
Coquille Creamery	"	1892 Prop.	1892 Prop.	C. Romander	Geo. S. Robinson	4000	72	Butter.
Willowdale Creamery	Arago	1899 Prop.	1899 Prop.	Tyrell & Woodward	J. L. Christiansen	2800	24	Butter.
Norway Creamery	Norway	May, 1900 Prop.	1900 Prop.	C. S. Davis	S. M. Kelly	2100	15	Butter.
Mountain Spring Creamery	Riverton	May, 1900 Prop.	1900 Prop.	T. A. North	T. A. North	3100	30	Butter.
Sugar Loaf Creamery	Myrtle Point	May, 1897 Prop.	1897 Prop.	W. H. Erdice	W. H. Erdice	2500	31	Butter and cheese.
Gravel Ford Cheese Factory	Gravel Ford	1893 Prop.	1893 Prop.	Fred Moser	Fred Moser	1400	19	Cheese.
Douglas County—								
Gardiner Creamery	Gardiner	1896 Prop.	1896 Prop.	W. P. Reed	Albert Janelle	6000	26	Butter and cheese.
Jackson County—								
Ashland Creamery	Ashland	1896 Prop.	1896 Prop.	D. Perozzi	D. Perozzi	4500	30	Butter.
Lane County—								
Douglas Creamery	Springfield	1891 Prop.	1891 Prop.	S. M. Douglas	J. B. Cotton	1500	1	Butter.
Pleasant Hill Cheese Factory	Goshen	1894 Prop.	1894 Prop.	Thos. Walker	Thos. Walker	950	14	Cheese.
Lincoln County—								
Elk City Cheese Factory	Elk City	1900 Prop.	1900 Prop.	F. M. Carter	Wm Bischel	500	—	Cheese.
Toledo Creamery	Toledo	1899 Prop.	1899 Prop.	Stewart & Center	J. F. Stewart	875	33	Butter.
Linn County—								
Albany Creamery	Albany	1895 Co-Op.	1895 Co-Op.	E. J. Seely	E. J. Seely	3400	52	Butter.
Shedd Skim Station	Shedd	1896 Albany Creamery Co.	1896 Albany Creamery Co.	Chas. Powers	Chas. Powers	1800	—	—
Tangent Skim Station	Tangent	1900 Albany Creamery Co.	1900 Albany Creamery Co.	W. L. Maple	W. L. Maple	1800	—	—
Plainview Creamery	Plainview	1897 Prop.	1897 Prop.	E. J. Seely	E. F. Rice	2300	32	Butter.
Stayton Skim Station	Stayton	1900 Prop.	1900 Prop.	E. J. Seely	Curtis Seely	1300	13	—
Scio Creamery	Scio	1896 Stock	1896 Stock	J. S. Morris	F. Morris	2500	32	Butter and cheese.

Brownville Creamery ..	Brownville	Apr. 1900	Prop.	Bruckman & Son	P. Bruckman	2150	40	Butter.
Marion County—								
Marion Creamery ..	Marion	1899	Prop.	J. D. & M. A. Barber	M. A. Barber	1000	10	Butter.
Silverton Creamery ..	Silverton	1900	"	P. K. Miller	P. K. Miller	1000	60	Butter.
Laurence Creamery ..	Laurence	1895	"	Geo. W. Weeks	Geo. W. Weeks	1200	10	Butter.
Laurence Cheese Factory ..	Laurence	1895	"	Isaac Stevens	J. D. Richmond	700	25	Cheese.
Salem Creamery ..	Salem	Apr. 1900	Co-Op	Geo. D. Goodhue	Geo. D. Goodhue	1200	80	Butter.
White Clover Creamery ..	"	Apr. 1900	Prop.	T. S. Townsend	M. McCrisky	700	100	Butter.
Salem Cheese Factory ..	"	Apr. 1900	Prop.	Schubinger	Schubinger			Pancy cheese.
Multnomah County—								
Barnes Market Co.	Portland	1896	"	Barnes Market Co.	Pred. Knecht	1500	60	Butter.
Kaupisch Creamery Co.	"	1898	Stock	J. C. Kaupisch	J. C. Kaupisch	6000	50	Butter.
Sunset Creamery ..	"	Mar. 1900	Stock	J. M. Hupfings	Alex Brank	3000	20	Butter.
Weatherly Creamery ..	"	Jan. 1900	Prop.	G. W. Weatherly	R. L. McCumay	1100	22	Butter.
Warren Skim Station ..	Warren	1899	Feeder	for Weatherly	E. W. Rennock	600	19	"
Pleasant Home Creamery ..	Orient	1900	Prop.	C. Kern	C. A. Kern	900	19	Butter.
Gresham Creamery ..	Gresham	1899	Stock	Lewis Shattuck	Chas Lewis	1020	26	Cheese.
Clifton Cheese Factory ..	Cleone	1898	"	J. Thomas	Paul Paulsen	1675	5	Cheese.
Tillamook County—								
Cloverdale Cheese Factory ..	Cloverdale	1897	"	Chas. Ray	Guy Ford	700	26	Cheese.
Hebo Cheese Factory ..	"	1893	"	Smith & Sons	E. P. Smith	300	5	Cheese.
Long Prairie Creamery ..	Tillamook	1899	"	H. Rogers	H. Rogers	1500	10	Butter.
Tillamook Dairy Association Creamery ..	"	1892	Co-Op	Mrs. S. Severance	Squire Doty	4700	48	Butter.
Tillamook Creamery ..	"	1895	"	J. B. Deleman	Joe Latta	3400	25	Butter.
Cold Spring Creamery ..	"	1895	"	J. H. Donaldson	J. H. Donaldson	1200	12	Butter.
Nestucca Cheese Factory ..	Nestucca	1897	Prop.	J. Nicklaus	J. Nicklaus, Jr.	500	8	Brick cheese.
Kuzee Cheese Factory ..	Tillamook	1896	Stock	A. & H. C. Kunze	John Beller	500	2	Brick cheese.
Bixby Cheese Factory ..	Beaver	1898	"	Joe Bixby	Joe Bixby	550	7	Cheese.
White Clover Cheese Factory ..	Oreton	1892	"	T. S. Townsend	W. A. Wheeler	2650	25	Cheese.
McIntosh Cheese Factory, No. 1 ..	Oreton	1898	"	P. McIntosh	W. A. Gray	1600	20	Cheese.
" " " " No. 2 ..	Beaver	1893	"	"	J. W. Hainer	1600	13	Cheese.
" " " " No. 3 ..	Tillamook	1899	"	"	Joe Pallen	1800	24	Cheese.
" " " " No. 4 ..	"	1900	"	"	Thos. Ballantyne	1000	30	Cheese.
Washington County—								
Blooming Creamery ..	Blooming	1897	Stock	Herman Koenke	Herman Thurner	2000	35	Butter.
Clover Lawn Creamery ..	Centerville	1895	Prop.	A. Reverman	Albert Reetton	1400	38	Butter.
Eagle Creamery ..	Buxton	1900	"	H. Peterson	H. Peterson	1200	28	Butter.
Farmington Creamery ..	Farmington	1896	Stock	Fred Kood	Henry DeDols	2000	14	Butter.
Forest Grove Creamery and Cheese Fact.	Forest Grove	1897	Prop.	J. S. Clark	J. S. Clark	1500	25	Butter.
Glencoe Creamery ..	Glencoe	1897	"	J. L. Bearse	J. L. Bearse	1700	22	Butter.
Golden Crown Creamery ..	Greenville	1895	"	J. J. Hartley	J. J. Hartley	1400	40	Butter.
South Tualatin (C) Creamery ..	Hillsboro	1893	Stock	Ed Schumacher	Ed Schorler	1800	23	Butter.
Yamhill County—								
Newberg Creamery ..	Newberg	1898	Stock	S. W. Atkinson	S. W. Atkinson	1000	18	Butter.
Star Cheese Factory ..	Lafayette	1900	Prop.	B. F. Childs	B. F. Childs	400	15	Cheese.
Totals ..						\$ 136,630	1733	

* Burned April, 1900. † Prop.—Proprietary. ‡ Co-Op.—Co-operative.

An inspection of the foregoing table shows that 17 of these 71 factories were established during the year 1900, as follows: 6 cheese factories, 9 creameries, and 2 skimming stations. But this increase in numbers does not necessarily signify a proportionate increase in total production over the preceding year, for several new factories have been established in localities where they have taken largely from the business of older established ones. Particularly is this true on the Coquille river in Coos county where four creameries in 1900 occupied the same territory covered by two in 1899, and with very little increase in the sum total of business for the four over that done by the two the preceding year. All of the factories, however, which have not had their territory cut into by new ones reported a better business up to September 1, 1900, than was done during the same period in 1899, this increase ranging all the way from practically none up to 40 per cent. But the ravages of the "cut worm," or "army worm" as some called it, greatly damaged the fall feed, and it is highly probable that some factories which showed a slight increase in business up to September 1st, when figures are made up for the whole year, will show a falling off from the business of 1899. Of course the total output of creamery butter and cheese for the year 1900 will be an increase over the amount produced in 1899, but what this increase will be the writer has no means of estimating with any degree of accuracy.

Some of the managers of the 54 factories reporting amount of business for 1899, preferred that the figures be not given publicly, and for this reason individual reports for each factory do not appear in this publication. The totals for the entire 54, however, are as follows:

Pounds of milk received	36,874,425
Pounds of butter fat received in milk	1,470,527
Pounds of butter fat received in cream	356,030
Pounds of butter made	1,631,134
Pounds of cheese made	1,115,016
Paid to patrons	\$ 416,905
Average per cent fat in milk	3.99
Average wages paid buttermakers per month	\$ 61.33
Average wages paid cheesemakers per month	58.60
Average wages paid skim station operators per month	40.00
Average price paid for butter fat	22.8c.

From the above figures, and from other information, the writer is of the opinion that the total output of creamery butter for the whole

state, even including that made on farms from separator cream, was not far from 2,500,000 pounds for the year 1899. In California and some other states careful estimates show that about one-half of the entire butter product for the year 1899 was factory made. If we use this basis of computation the entire butter production for the state of Oregon for the year 1899 would be about 5,000,000 pounds. It is probable that hardly one-half of the butter of the state is factory made, hence this estimate of total production may be a trifle too low, but in the absence of any accurate figures for the production outside of creameries, the writer feels that this estimate is the best that can be made.

The cheese factories embraced in the foregoing table show a production of 1,115,016 pounds of cheese. The product of the few factories not listed and of individual makers would doubtless bring the cheese product of 1899 up to about 1,500,000 pounds for the entire state.

The largest amount of butter produced by any one factory in the state was 252,587 pounds by the Barnes Market Co., of Portland. The largest amount of cheese was approximately 275,000 pounds, made by Mr. P. McIntosh in his factories in Tillamook county.

The business done by the four largest factories operated on a co-operative basis is shown by the following table:

TABLE II.

1899.	Coos Bay Creamery	Tillamook Dairy Association	Albany Creamery Company	Tillamook Creamery Association
Pounds of milk received	2,300,563	2,774,494	1,675,580	1,364,873
Pounds of cream received	210,035			
Pounds of butter fat received	154,886	111,304	68,540	53,352
Pounds of butter made	158,690	128,502	78,821	3,183
Pounds of cheese made	51,034			135,168
Average per cent fat in milk	4.53	4.01	4.10	3.90
Capital invested in plant	\$ 9,000	\$ 4,715	\$ 3,400	\$ 3,300
Amount paid patrons	33,518	22,987	14,452	13,392
Average price paid for butter fat	21.64 cts.	20.65 cts.	21.09 cts.	25 10 cts.
Wages of operator per month	\$ 75.00	\$ 55.00	\$ 75.00	\$ 66.06 ² / ₃
Wages of helper per month	45.00	20.00	40.00	17.50
Wages of secretary or manager per month	75.00	20.00	*	20.00

* At the Albany creamery the buttermaker also acts as secretary and manager.

The 210,035 pounds of cream received at the Coos Bay creamery contained 50,544 pounds of butter fat.

The average price paid per pound for butter fat at the factories of the Tillamook Dairy Association and the Tillamook Creamery Association are a fair indication of the returns that may be expected

from milk delivered at a creamery and at a cheese factory. The former factory made butter only, while the product of the latter was practically all cheese, the 3,183 pounds of butter being made during a portion of the winter when the milk supply was very light. The table shows that the cheese factory was able to pay nearly four and a half cents more per pound for butter fat than the butter factory. These two factories are located within three miles of each other, and the management of each is, in all essential features, conducted on the same plan, so the comparison is a very fair one. The cheese factory is perhaps at a little disadvantage as it handled only one-half as much milk as the butter factory. In this connection it should be remembered that the whey from a cheese factory has only about one-half the feeding value that the skim milk from the creamery has.

Coos county leads in the production of butter, while Tillamook leads in the production of cheese, a summary of the factory business in these two counties being shown in the following:

TABLE III.

Year of 1899.	Tillamook Company.	Coos Co.
Pounds milk received.....	11,034,280	9,392,619
Pounds cream received.....		218,977
Pounds butter fat received.....	433,341	424,505
Pounds butter made.....	191,786	399,560
Pounds cheese made.....	701,187	182,831
Average per cent fat in milk.....	8.98	4.52
Amount paid to patrons.....	\$ 101,413	\$ 91,368
Average wages of makers per month.....	62.60	62.80
Average price paid for butter fat.....	23.4 cts.	21.8 cts.

The product of Ten Mile creamery, located at Lake, Coos county, is not included in the above summary as no report was secured from said factory. A rough estimate, however, from parties familiar with conditions at this place, indicates that the value of the 1899 product would be under rather than over \$4,000.

While the farm separator is used to a considerable extent in Coos county, the cream is mostly sent to the factories, the writer learning of but two parties who made up their own butter from the farm separator cream. In Tillamook county there are many such little individual plants or "separator dairies" as they may be called. Knowledge was gained of no less than fifteen such places in the county with an estimated output of over 60,000 pounds of butter. There are also many individual cheese plants in Tillamook county.

Five of these were visited which reported a yearly output of about 28,000 pounds of cheese. Coos county cheese is practically all made in the larger factories.

In addition to the factories mentioned in Table I, the following are known to have been in operation during the year 1899:

Ten Mile Creamery, Lake, Coos county.
 O. W. Hurd Creamery, Florence, Lane county.
 W. H. Cross Creamery, Halsey, Linn county.
 Ft. Klamath Creamery, Ft. Klamath, Klamath county.
 Bethany Co-op. Cheese Factory, Bethany, Washington county.
 Swiss Co-op. Creamery Company, Lenox, Washington county.
 Salem Creamery Company, Lyons, Linn county.
 Ogden Creamery, St. Johns, Multnomah county.

The following are believed to be in operation at the present time as they were being built during 1900:

Gus. Proebstel, Skim Station, Philomath, Benton county.
 Ranier Creamery Company, Ranier, Columbia county.
 Noon's Creamery, Warren, Columbia county.
 Acme Creamery, Acme, Lane county.
 E. J. Seely's Creamery, Albany, Linn county.
 A. McMaster's Creamery, Lebanon, Linn county.
 Independence Creamery, Independence, Polk county.
 Bethany Creamery, Bethany, Washington county.
 Townsend Cheese Factory, Sheridan, Yamhill county.

The following factories are known to be in operation in the eastern portion of the state:

Ukiah Creamery, Ukiah, Umatilla county.
 McReynold's Creamery, Ukiah, Umatilla county.
 Milton Creamery Company, Milton, Umatilla county.
 Cove Creamery Company, Cove, Union county.
 E. M. Sanders Creamery, North Powder, Union county.
 Pine Grove Creamery, Ukiah, Umatilla county.
 Alba Creamery, Alba, Umatilla county.

METHODS OF OPERATION.

Reference to Table I will show at a glance that very few of the Oregon creameries and cheese factories are organized on a co-operative basis. Furthermore, even these few are not strictly co-operative, but are more of the nature of stock companies, for in no case do the parties furnishing milk own all of the stock of the concern, and many persons who do furnish milk own no stock. To be strictly co-operative no one who does not furnish milk should own stock, and everyone who does furnish milk should own stock in the con-

cern. In the Tillamook Dairy Association, which is commonly cited as one of the most successful instances of co-operation in the dairy line, the creamery stock is owned by 33 shareholders, while the milk is furnished by 45 to 50 patrons. In this case most of the shareholders are patrons of the creamery but not all of them are. Then the management is not strictly co-operative, for a fixed price is charged the patrons for making up the butter. During the past two years this price has been two and one-fourth cents per pound.

The Albany Creamery Association is a stock company, a considerable portion of the creamery stock being owned by the business men of the town of Albany. This concern is generally considered the most successful instance of creamery co-operation in the Willamette valley, its business having gradually increased each year since its organization in 1895. The outline of this company's method of dealing with its patrons is as follows: From the gross receipts for the month is deducted, *first*, the general operating expenses of the creamery; *second*, one cent for each pound of butter fat delivered to be set aside as a sinking fund; *third*, an amount equal to the twelfth part of the annual interest on the paid up stock at the rate of eight per cent per annum. The amount remaining after these deductions have been made is divided pro rata among the patrons, according to the number of pounds of butter fat each has delivered in his milk. The Board of Directors of this institution showed their good business sense in engaging a first-class buttermaker when the creamery was first put in operation, and in retaining this same buttermaker ever since.

Another plan of operation which is quite popular in Washington county, particularly with the Farmington, South Tualatin, and Blooming creameries, is about as follows: An organization known as the Creamery Company owns the manufacturing plant. In the above mentioned creameries this company consists of eight, four, and eleven shareholders, respectively. Then there is an organization known as the Creamery Association composed wholly of those who furnish milk to the creamery. The creamery company enters into a contract with the creamery association to manufacture the milk delivered into first-class butter and deliver same in the city of Portland at a stipulated price per pound, usually 3½ cents. All accounts of the patrons are kept by the secretary of the creamery association whose remuneration is a stipulated price of 15 to 25 cents for each monthly statement made to each patron. The

general operating expenses of the creamery are to be paid by the creamery company from the stipulated price received for each pound of butter made.

Among the proprietary concerns probably the more common method of dealing with the patrons is the charging of a stipulated price for each pound manufactured. This price ranges from 2 to 4 cents per pound for butter, and $1\frac{1}{2}$ to 2 cents for cheese. These prices are for the actual work of manufacturing and do not include the expense of shipping and selling, nor the delivery of the milk to the factory, which is generally done by the patrons, either individually or by some common carrier. Other proprietary factories purchase the butter fat in the milk or cream paying for it "what the market will warrant," to use the words of one of these owners. However, a more definite understanding than this is usually required, and many of these factories agree to pay such a price for the butter fat as will be so many cents below the market price of creamery butter during that month. Where this basis of payment is used the price for the butter fat is usually two and a half cents below the market price of butter.

During the past two years several butter factories have been established which handle no milk, the separating being done on the farms where the milk is produced and the cream only sent to the factory. The acknowledged superiority of separator cream over that obtained by skimming from pans, cans, crocks, etc., is recognized by these creameries, and it is customary to pay a higher price for the separator cream than for the "hand skimmed" cream, the difference usually being two cents per pound of butter fat contained in the cream.

The use of the Babcock test for determining the value of milk and cream, is universal among the factories of the state. No other basis of computation was reported by any one of the 71 factories visited. This fact was very gratifying to the writer, indicating that the Oregon dairymen, both producers and manufacturers of milk, were thoroughly up to date in this respect. It is doubtful if any other state can show such a general use of the Babcock test. The report of the Iowa Dairy Commissioner for the year 1899 shows that 12 per cent of the creameries and 69 per cent of the cheese factories in that state still purchase milk on the old unjust and unfair basis of so much per hundred weight, regardless of quality. Pretty much the same condition no doubt prevails in the other dairy states of

the Middle West, for Iowa is the first state in the Union in quantity of creamery butter produced annually.

This condition of affairs is due largely to the tendency on the part of people to continue in the "same old rut" rather than make a change in their methods. Prior to the introduction of the Babcock test in the year 1890, the practice of buying milk by the hundred weight, regardless of quality, was universal. Both producers and manufacturers realized that the method was unfair, but there was no simple method by which the per cent of fat in the milk could be determined. Dr. Babcock's invention solved the problem and his milk test was quickly adopted by the progressive factory-men, while the old fogies continued in "the good old way." The Oregon creameries and cheese factories, having practically all been established since 1892, were furnished with the Babcock test as a part of their original equipment, hence there has been no occasion to change from the "pooling system" to the "test system."

There is one point in connection with the use of the Babcock test that has been the cause of much contention, due in some cases to ignorance, but usually to purposely misleading statements on the part of creamery owners or operators. This is the matter of the "overrun," "over churn" as it is sometimes called. The claim has often been made by creamery men that the Babcock test shows the amount of butter that can be made from the milk tested. For instance, if a sample of milk tests 4.5 per cent, some creamerymen claim that one hundred pounds of such milk would make four and one-half pounds of butter. But the facts in the case are that such milk should make more than four and one-half pounds of butter, and this additional amount constitutes the "overrun." The Babcock test indicates the actual amount of pure butter fat present in the milk. Butter, when properly churned, salted and worked, contains about 3 per cent of salt, 11 per cent of water, 1 per cent of casein and albumen, and 85 per cent of butter fat. If the butter fat could all be made into butter there would be an overrun of about one-sixth, but there are always losses in the skim milk and butter milk, losses from cream adhering to the vats, buckets, etc., used in handling it, and other losses more or less unavoidable. And these losses vary considerably with the skill of the operator, and with the machinery used. But in ordinary creamery practice there is an "overrun" of 10 to 15 per cent. That is, for every 100 pounds of butter fat delivered to the creamery in milk or cream, there should

be produced 110 to 115 pounds of butter. But this "overrun" need not be considered in making payments for the milk delivered as additional work would be made thereby, and nothing would be gained in fairness of distribution. To illustrate: Suppose the accounts of a creamery for one month show that there has been received in the milk delivered during that month 8,400 pounds of butter fat, and that from this butter fat 9,450 pounds of butter have been produced. In this case the overrun would be $12\frac{1}{2}$ per cent. Suppose the gross receipts for the month were \$1,889.50, and all expenses, including making, marketing, sinking fund, etc., amounted to \$377.50. There would be left \$1,512.00 to be divided among the persons furnishing the milk or cream. If payment were made according to the number of pounds of butter each patron had furnished in his milk the price per pound would be $\$1,512.00 \div 9,450 = 16$ cents. If the payment was made according to the actual pounds of butter fat delivered, the price per pound would be $\$1,512.00 \div 8,400 = 18$ cents. Hence it will be seen that if the butter is paid for there will be more pounds but the price per pound will be less than if payment is made according to the number of pounds of butter fat, and the accountant will be required to make one additional multiplication for each patron. To illustrate further: Suppose Mr. Brown has delivered 6,160 pounds of milk testing 4.0 per cent. Then $6,160 \times .04 = 246.4$ pounds of butter fat, and $246.4 \times 1.12\frac{1}{2} = 277.2$ pounds of butter. Then

246.4 lbs. butter fat at 18 cents- \$44.35,
and 277.2 lbs. butter at 16 cents- \$44.35.

The amount due Mr. Brown is thus seen to be the same whether he be paid for butter or butter fat.

ORGANIZATION.

In the establishment of either a creamery or cheese factory on the co-operative plan, or as a stock company, certain rules and regulations must be adopted for the government of the company. The Albany Creamery, the Tillamook Dairy Association, and the Blooming Creamery have each been referred to as being very successful organizations, and the regulations adopted by each are given here-with, beginning with the Albany Creamery:

ARTICLES OF INCORPORATION--ALBANY CREAMERY ASSOCIATION.

ARTICLE I. The name assumed by this incorporation and by which it shall be known, is the Albany Creamery Association, and its duration shall be perpetual.

ART. II. The business of the corporation shall be to locate, establish and erect a creamery plant, and to purchase or procure milk in any manner it may

deem proper; also to manufacture and sell any and all products thereof; and to utilize the refuse products of said creamery for the purpose of fattening hogs or any other animals; also to purchase and hold any real or personal property necessary or convenient for the transaction of its business. Also that said corporation be run on the co-operative plan; and that any proceeds arising from the sale of any of its products shall be disposed of as follows: 1st. To pay for the milk and product of milk bought for the use of said creamery. 2d. To pay the operating expenses and necessary repairs of the plant of said corporation. 3d. To pay legal interest to the stockholders of said corporation. 4th. The remainder to be paid to the patrons of said corporation who furnish the milk product, in proportion to the value of the product furnished.

ART. III. No stockholder shall vote more than one share on any question.

ART. IV. The principal office or place of business of said corporation shall be in Linn county, and at or near Albany.

ART. V. The amount of capital stock of said corporation shall be \$5000 divided into 100 shares.

BY-LAWS.

I. This association shall have the following officers: President, Vice-President, Secretary, Treasurer, and five directors.

II. The annual meeting for the election of directors shall be held on the second Thursday in January of each year. And within ten days thereafter said directors shall meet and organize by electing one of their number President, and one Vice-President, and from the stockholders elect a Secretary and a Treasurer. The directors or officers are to hold their offices until their successors are elected and qualified; and in case of a vacancy in any office the directors may elect some one to fill the vacancy at any meeting.

III. A majority of the Board of Directors shall constitute a quorum.

IV. The duties of the President, Vice-President, Secretary, and Treasurer shall be the same as laid down by Roberts' Rules of Order for said officers, and all meetings shall be governed by said rules; *Provided*, the Board of Directors may at any time require different services of any of said officers, as in their opinion would be for the best interests of the Association.

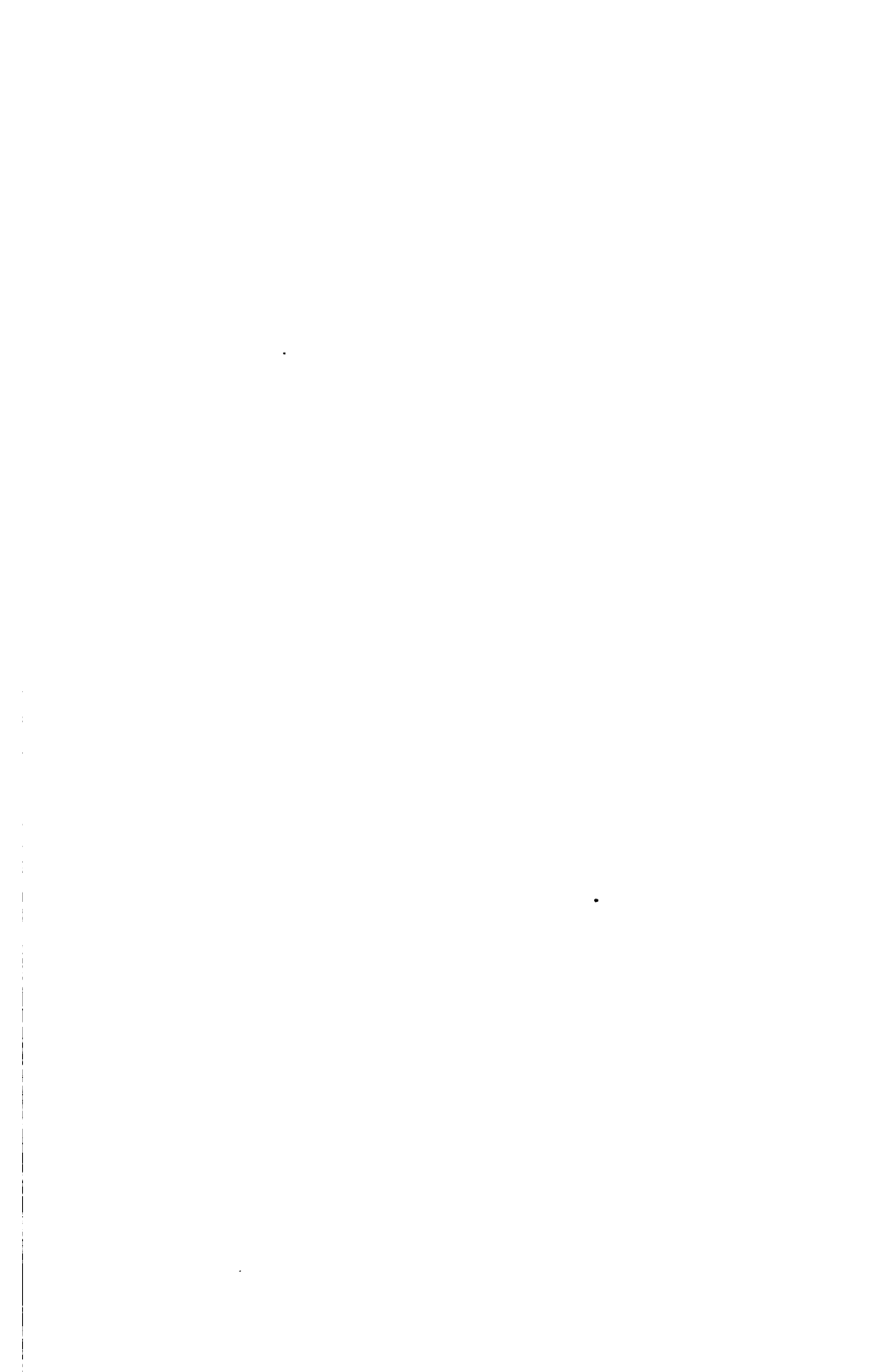
V. The duties of the Board of Directors shall be to have the general management of the business of the Association, and they shall have full power to employ or discharge employes, make contracts and do any and all things necessary to carry out the aims and purposes of this Association; and shall from time to time make such rules for the government of milk patrons and employes of the Association as they may deem for the best interests of the Association; and they shall make or cause to be made, at the annual meeting of this Association each year, a full and complete statement of the financial condition of the Association together with the amount of business transacted; and they shall meet at least once a month, and oftener if they choose for the transaction of any business of the Association that may need attention.

VI. On the fifteenth of each month shall be pay day, when all milk patrons and laborers shall receive pay for their product or services up to the first day of that month.

VII. The officers of this Association shall serve without compensation.

VIII. These by-laws may be altered or amended at any stockholders' meeting by a majority vote of the stockholders present.

The Tillamook Dairy Association began operations in 1892, and has been doing a big business ever since. The present secretary of the Association, Mrs. S. Severance, has held the position for the past six years, and the writer wishes to state right here that this lady seemed to have the business affairs of the Association perfectly in hand. If any man doubts the ability of a woman to fill such a





Ashland Creamery.



Albany Creamery.

position he would have his doubts quickly dispelled by an inspection of Mrs. Severance's accounts. The regulations by which this Association is governed are given herewith:

BY-LAWS OF THE TILLAMOOK DAIRY ASSOCIATION.

Section 1. There shall be elected at each annual meeting three directors and one treasurer who shall hold their offices for one year and until their successors are duly elected and qualified, unless removed as hereinafter provided for. In case of vacancy in either of said offices the directors shall immediately call a stockholders' meeting at which such vacancy shall be filled. If any officer shall remove from the county or be permanently incapable of serving by reason of illness the office shall be declared vacant.

Sec. 2. The Treasurer shall act as keeper of the funds of the corporation. He shall keep account of all money received and paid out. He shall pay out money only on the order of the Secretary, countersigned by the President. He shall give bonds in the sum of \$2,000 00 or such other sum as the board of directors shall exact; said bond to be approved by the directors.

Sec. 3. The Board of Directors shall have the power vested in them by law, and such further power as may be granted by these by-laws. Their power shall be at all times subject to the direction of the stockholders expressed at a regularly held meeting.

Sec. 4. The Board of Directors shall have power to call a special meeting of the stockholders. In order to do so they shall cause a notice, specifying the time and place and object of such meeting, to be properly mailed to each stockholder ten days before the proposed meeting. Nothing shall be passed upon at such meeting except what has been specified in the notice.

Sec. 5. The directors at their first meeting shall elect one of their number president as provided by law, and a secretary. They shall perform the duties the law enjoins and such further duties as are herein provided for.

Sec. 6. The Secretary shall keep an accurate account of all the receipts and expenditures of the Association. Upon having authority in writing from not less than two of the Board of Directors, he shall issue drafts upon the treasurer for the payment of all money due from the Association. He shall have ready at monthly meetings of the directors, a list of all persons delivering milk to the factory, and the amount due each person. He shall also furnish a statement of all orders drawn by him on the treasurer. He shall act as book-keeper of the corporation. He shall only issue drafts upon order of the Board of Directors.

Sec. 7. The directors shall meet at the office of the secretary on the 15th day of each month, when they shall examine the books and accounts of the secretary, and transact any other business properly coming before them.

Sec. 8. The President shall sign all checks passing through the hands of the Secretary.

Sec. 9. The Secretary shall receive such compensation for his labor as the directors shall deem just and equitable, and shall give bonds in the sum of \$1,500 00 or such further sum as the Board may require. His salary shall not exceed \$25.00 per month.

Sec. 10. The regular stockholders' meeting shall be held on the fourth Monday in February of each year in the court house at Tillamook City at the hour of one o'clock in the afternoon, and at such annual meeting all business may be transacted proper to be done at a stockholders' meeting.

Sec. 11. The President shall call a special stockholders' meeting when requested so to do in writing by not less than ten stockholders. Such meeting must be called in the same manner as provided in Sec. 4, and shall have the same power.

Sec. 12. The Stockholders shall have power to remove any or all of the directors, or the Secretary, and shall have power to fill all vacancies.

Sec. 13. No stockholder shall be allowed to own more than four shares of stock in the Association.

Sec. 14. No stockholder shall be liable for any amount over and above his subscription of capital stock.

Sec. 15. It shall be the duty of the Board of Directors to at once take necessary measures to insure the use of pure milk at the factory. If proper inspection of dairy farms can be had by the state officials such shall be done; if not, it is hereby made the duty of the Board of Directors to make, or procure to be made, the necessary inspection.

Sec. 16. Such suggestions shall be made to the owners of dairies as may seem necessary in regard to the care of stock, barns and milk.

Sec. 17. The Board shall cause to be prepared a simple system of rules in regard to the care of stock, barns, and milk appliances, and have the same published and distributed among the patrons.

Sec. 18. It shall be the duty of the directors to refuse to receive or allow to be received at the factory, any impure, unclean, or infected milk from patrons who willfully disregard and violate the rules and suggestions of the directors, or of the state inspector.

Sec. 19. Nothing shall be done at a directors' meeting unless two or more directors be present. At least one-half of the subscribed shares of stock must be represented at a stockholders' meeting in order to constitute a quorum.

Reference has already been made to the plan of operation adopted by certain creameries in Washington county, viz: Farmington, South Tualatin, and Blooming creameries. Each of these creameries is owned by several individuals known as the Creamery Company, and the milk is furnished by an organization known as the Creamery Association. Through the courtesy of the secretary of the Blooming Creamery, the constitution and by-laws of this association together with the agreement with the Blooming Creamery Company, were obtained and are herewith presented:

Article I. The name of this association shall be The Blooming Creamery Association.

Art. II. The object of this Association shall be the manufacture and sale of butter and other dairy products.

Art. III. Any person signing this constitution and furnishing milk to this association shall be a member thereof.

Art. IV. Every member of this association shall be entitled to one vote regardless of the amount of milk he furnishes.

Art. V. The officers of this association shall consist of President, Secretary, and Treasurer, which officers shall constitute the board of managers.

Art. VI. The officers of this association shall be elected annually, and shall hold their offices until their successors are duly elected and qualified.

Art. VII. The duty of the President shall be to preside at all meetings, and call special meetings upon request of three or more members. He shall give notice of such special meetings at least five days before hand.

Art. VIII. It shall be the duty of the Secretary to keep a record of the minutes of all meetings, and perform all correspondence of this association, and all other business that generally devolves upon such an officer.

Art. IX. It shall be the duty of the Treasurer to collect and keep all funds and disburse the same under the direction of the board of managers.

Art. X. The officers of this association shall receive no compensation for their services unless hereafter agreed upon by the association.

Art. XI. The annual meeting of this association shall be held on the first Monday in November.

Art. XII. Not less than nine members shall constitute a quorum at all meetings.

Art. XIII. There shall also be elected a Testing Committee consisting of three members to be elected as follows: One to hold his position for one year; one to hold his position for two years; and the third member to serve for three years; new members to be elected for a term of three years. The duty of this committee shall be to do the necessary testing at the creamery, at least three times each month, and two members always to be present.

Art. XIV. The constitution of this Association can be amended at any regular meeting by a majority of the members present.

Agreement made by Blooming Creamery Association, party of the first part, and Blooming Creamery Co., party of the second part:

We, the undersigned members of the Blooming Creamery Association, party of the first part, agree to furnish milk to the Blooming Creamery Company in good condition.

We, the Blooming Creamery Company, party of the second part, agree to make a first class article of butter from the above mentioned milk, and deliver the same in the city of Portland for the price of three and one-half cents per pound.

EQUIPMENT OF CREAMERIES AND CHEESE FACTORIES.

Location.—In the establishment of a creamery or cheese factory one of the most important points is the securing of a proper site, and the matter of drainage is a very important consideration in this connection. The foundation of cleanliness in a creamery is its sewer system, and if there is any place where the old maxim, "cleanliness is next to godliness," applies, it certainly is in the creamery or cheese factory. A creamery, then, should generally be located on a slight eminence or a side hill, and if near a considerable stream of water, so much the better. The sewer should be of the regulation glazed sewer pipe, fitted with a properly protected trap next the building. Ordinary drain tiles are not well adapted to this purpose.

Another very important point to be considered in selecting a site is the water supply. In western Oregon there is practically no natural ice, and the high price of artificial ice places it beyond the reach of most creameries. Hence water must, in most cases, be wholly depended upon for cooling purposes, and it is essential that the water be as cold as possible for creamery use. In a few cases spring water can be used to good advantage, but the main dependence must be placed in wells, and an inspection of the temperature of the water of many creamery wells shows it to seldom be below 52° F. in summer time, when cold water is most badly needed. Butter makers, who have been trained wholly in a section where ice was plentiful, find themselves greatly handicapped in the western Oregon creameries where manufactured ice is not available. Out of the 71 creameries and cheese factories visited, but 14 report the use of ice. A butter maker in one of the large coast creameries says he

lost 100 pounds of butter in the buttermilk in two days, which he could have saved had ice been available. This particular creamery is so situated that its water supply must be piped a long distance, and the two days mentioned being unusually warm ones for the coast regions, the water supply became warmed up more than usual. But the loss during the summer weather, at all of the Oregon creameries which do not use ice, is greater than it should be, and there is no question in the writer's mind regarding the advisability of establishing an artificial refrigeration plant in connection with some of the larger creameries.

Construction.—In general it may be said that the principles of house construction will apply in the building of creameries or cheese factories. They should be placed on good foundations rather than on blocks or piers; should be well built to give protection against the heat of summer and the cold of winter, particularly the former in the absence of ice; and should be well lighted and well ventilated. Owing to the cheapness of first class lumber in western Oregon, creamery floors are most commonly made of wood, but in some cases cement floors are used, particularly in the churning rooms. Of whatever material the floor is composed it should slope toward a well constructed gutter so all water will readily drain off. At the point where it is desired to place the separator, a brick or stone pier well covered with cement, should project through the floor about two inches. Upon this pier the separator should be placed thus affording a solid foundation which is essential to the proper working of a cream separator. A slope of one inch fall in five feet will be found to furnish good floor drainage. A floor space 20x40 feet, with an annex 20x20 feet for boiler, engine and fuel, will be found to furnish ample room for working up the milk of 300 to 500 cows.

There are two general plans which are followed in the interior arrangement of creamery buildings. In the one, the milk is taken in at such an elevation that it may flow by gravity from the weigh can to the receiving vat, thence to the tempering vat, thence to the separator, and finally to the skim milk and cream vats. In the other, the milk is taken in at a height not much above the level of the work room floor, and is elevated to the tempering vat and separator by means of pumps. As a matter of course each plan has its advocates. The main advantage of the first named or "gravity" system is that the milk flows by its own weight during the whole process of manufacture, thus doing away with pumps, which are always

troublesome to keep clean. But this system necessitates much ascending and descending of steps or stairs. The pumping system on the other hand, saves the labor item of running up and down steps, but introduces one or more pumps for elevating the milk, which are always more or less difficult to keep clean, and extremely liable to be neglected. The difference in the two plans therefore simply reduces itself to a choice between climbing steps, and keeping milk pumps clean, and in operation when needed.

Equipment.—In order to secure Oregon prices on the apparatus required for properly outfitting creameries and cheese factories, letters were written to the two creamery supply houses located in Portland, requesting them to send lists of apparatus and prices at which same could be furnished. Following is the list submitted by one of the firms for a creamery:

PORTLAND, OREGON, NOV. 9, 1900.

Prof. F. L. Kent, Corvallis, Oregon:

DEAR SIR:—In conformity with the wish expressed in your favor of 5th, I herewith beg to enclose a list of outfitting for a 300 cow creamery, which I hope will be useful to you. Thanking you for the intention you have of giving me credit for the same in your publication, I am

Yours very truly,

GEO. L. BICKEL.

One Alpha No. 1 belt separator, capacity 3000 lbs. per hour. One separator tempering vat, with automatic milk feed faucet. One 60 gallon weigh can, with 3 inch Perfection gate. One 600 lb. double beam creamery scale. One 300 gal. milk receiving vat, with steam and water connections. One 200 gal. cream ripening vat, with steam and water connections. One 8 ft. Bair cream cooler and conductor. One rotary force milk pump. One No. 3 Disbrow combined churn and worker. One No. 5 Jumbo butter molding and cutting machine, capacity 132 squares. One galvanized iron skim milk tank, 30 gals. One skim milk jet pump, for elevating same. One Barber Colman check pump, to equally distribute skim milk to patrons. One Facile Babcock testing machine, 24 bottle capacity. Two Babcock cream testing bottles. One Babcock skim milk testing bottle, Ohlsson pattern. One bottle sulphuric acid. One Scoville milk sampler. One package composite test preservaline. Three doz. composite sample bottles. One set number tags for same. One wash sink, with extension end. One McDaniel suction tee, 1 in. One conductor head. Six ft. conductor pipe, 4 in. One combined cream and buttermilk strainer. Two 14 qt. factory pails. One standard float thermometer. One 8 oz. graduate for acid. One 4 oz. graduate for butter color. One package Farrington acidity test alkaline tablets. One Spillman acidity test graduate cylinder. One hair salt sieve, 12 in. diameter. One Rensselaer salting scale, 240 lb. double beam. One butter bowl. Two factory ladles. One long handle ladle for stirring cream vat. One creamery end stamp. Two vat brushes, Alligator pattern. Two Jersey can brushes. Two bottle brushes for cleansing sample bottles. One floor mop, with rubber tip. One dozen factory milk receiving sheets. One 8 horse power boiler complete with injector and all fittings. Fifteen ft. smokestack with guy wires. One 6 horse power engine with sight feed lubricator. One covered crank suction and force pump with tight and loose pulleys. Twenty ft. 1 7-16 shafting. Two end collars for same with set screws. Four 1 7-16 adjustable drop hangers with drip cups. Five wood split pulleys, necessary sizes to run

machines at required speed. Forty ft. 6x4 ply rubber belting for engine and churn. Twenty-five ft. 2½ in. leather belting for separator. Fifty ft. 2½ x 3 ply rubber belting for pumps. Three copper oilers. Five gallons separator oil. Five gallons engine oil. One gallon cylinder oil. Twenty-five ft. 1 x 4 ply rubber water hose with nozzle. Twenty-five ft. ½ x 4 ply steam hose. Necessary pipe and fittings, valves, etc.

"The above list is computed for a 300 cow butter plant, and an outfit selected from the same would cost from \$1,000 to \$1,500. The additional cost for increased size machinery and power for a 500 cow plant would amount to \$800 to \$1,000 additional."

The other Portland supply house submitted the following lists, the first being for a cheese factory, and the second for a good sized "separator dairy:"

PORTLAND, OREGON, Dec. 10, 1900.

Prof. F. L. Kent, Corvallis, Oregon:

DEAR SIR:—It has taken us longer than we anticipated to get at the matter of furnishing you with lists of dairy and cheese making outfits, which we now enclose herewith.

At the present prices, the cheese factory outfit, which we have enumerated, will cost in the neighborhood of \$400.00. The dairy outfit, the list of which we have sent you, can be furnished at the present time for about \$210.00. These lists, of course, can be changed to suit the ideas of individual dairymen and factory operators. We have included in our lists machinery that we recommend for use under usual conditions.

Trusting the lists may be of service to you and that they will reach you in good time, we are,

Yours respectfully,

G. G. WICKSON & CO.

CHEESE FACTORY OUTFIT.

For making cheese from the milk of from 200 to 300 cows.

One 6 H. P. vertical tubular steel boiler complete. One 600 gallon Curtis channel bottom cheese vat with steam connections. One Pohl curd mill. One Fraser gang cheese press 14 in. x 16 ft. Eight Fraser self-bandaging cheese hoops complete 14 x 5 in. One 400 lb. double beam creamery platform scale. One 60 gallon channel bottom self-draining weigh can with 3 in. Perfection gate. One 14 blade perpendicular curd knife. One 6 x 20 in. horizontal curd knife. One milk conductor head. Six feet open milk conductor pipe. One flat side curd pail. One 1 gallon dipper. One curd scoop. One whey strainer for channel bottom vat. One iron head rubber mop. Two glass floating dairy thermometers. One 24 bottle steam turbine Babcock milk tester. One factory account book.

DAIRY OUTFIT.

For 25 to 50 cows.

One hand separator, capacity 500 pounds per hour. One 50 gallon Curtis channel bottom cream vat with perfection gate. One 80 to 90 gallon barrel or trunk cover churn. One No. 4 Water's butter worker. One 4 bottle Babcock milk tester. One "Oregon" butter moulding and cutting apparatus. One 4 ounce graduate measuring glass. Two glass floating dairy thermometers. One 8 inch hair sieve or buttermilk strainer. One 14 quart heavy dairy pail.

Cost of Buildings.—In collecting the information relative to value of plant set forth in Table I, the estimated value of the building was obtained in most cases, separately from the cost of the equipment. The cost of the creamery buildings was found to range from \$200.00 for those of small capacity up to \$4,500.00 for the larger factories. The most expensive buildings are located on bays and rivers, where it is necessary to drive piles upon which to build. Then it is necessary to build a wharf for unloading milk, wood and other supplies, for some of these creameries do not have a road within a mile of them. But ordinarily the cost of an average sized building for creamery purposes in western Oregon need not exceed \$600.00, and some very fair creamery buildings are in use which have been constructed for \$400.00. The equipment, as already stated, can be put in for about \$1,500.00, but for most satisfactory results the cost of equipment will be somewhat higher. A good sized horizontal boiler, set in brickwork, is the proper thing for creamery use as it saves fuel and labor in keeping up steam. But there are many creameries equipped with small upright boilers, such as are given in the preceding list of apparatus. Three of the latest built creameries in the state, having a capacity of upwards of 300 cows, report the cost of building and equipment at about \$2,100. Should it be desired to handle cream only, as is the practice in some cases, the cost of equipment will be cut down by a sum equal to the value of the separator, or about \$500.00.

Owing to the fact that no separator or engine is required in a cheese factory, the cost of equipment of such factories is much less than in the case of creameries, and reports show that cheese factories now in operation have been equipped for amounts ranging from \$500.00 to \$800.00. It being necessary to keep cheese on the curing room shelves for three weeks, and often much longer, a larger floor space is required in a cheese factory than in a creamery handling the same amount of milk. In many cases the factories are built two stories in height, the upper story being used for the curing room, and in some cases as living rooms for the cheese maker and his family. The larger floor space required in cheese factories makes the cost of construction of the buildings rather higher than in the case of creameries of similar capacity. Mr. P. McIntosh of Tillamook owns four factories which he reports were each established at a cost of about \$800.00 for the construction of the building and about the same amount for equipment, thus making the cost of the

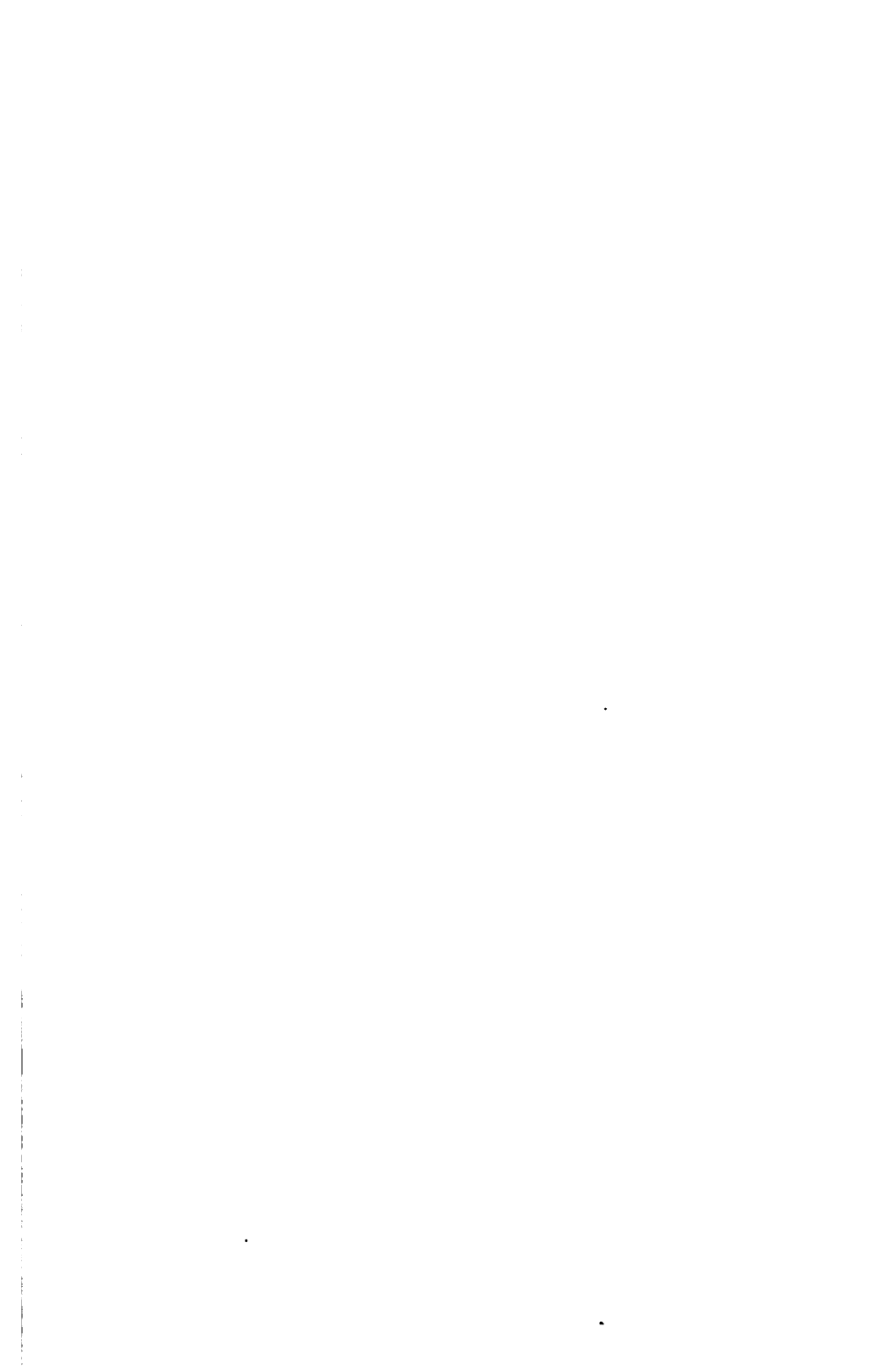
factory complete about \$1,600.00. There are no better cheese factories in the state than those owned by Mr. McIntosh, but his factories, while well built, are not at all showy, indicating that the money has been judiciously expended. These factories are larger than might be required for the needs of some localities, but it is doubtful whether a well built factory suited to the needs of any locality could be put in operation for less than \$1,500.00.

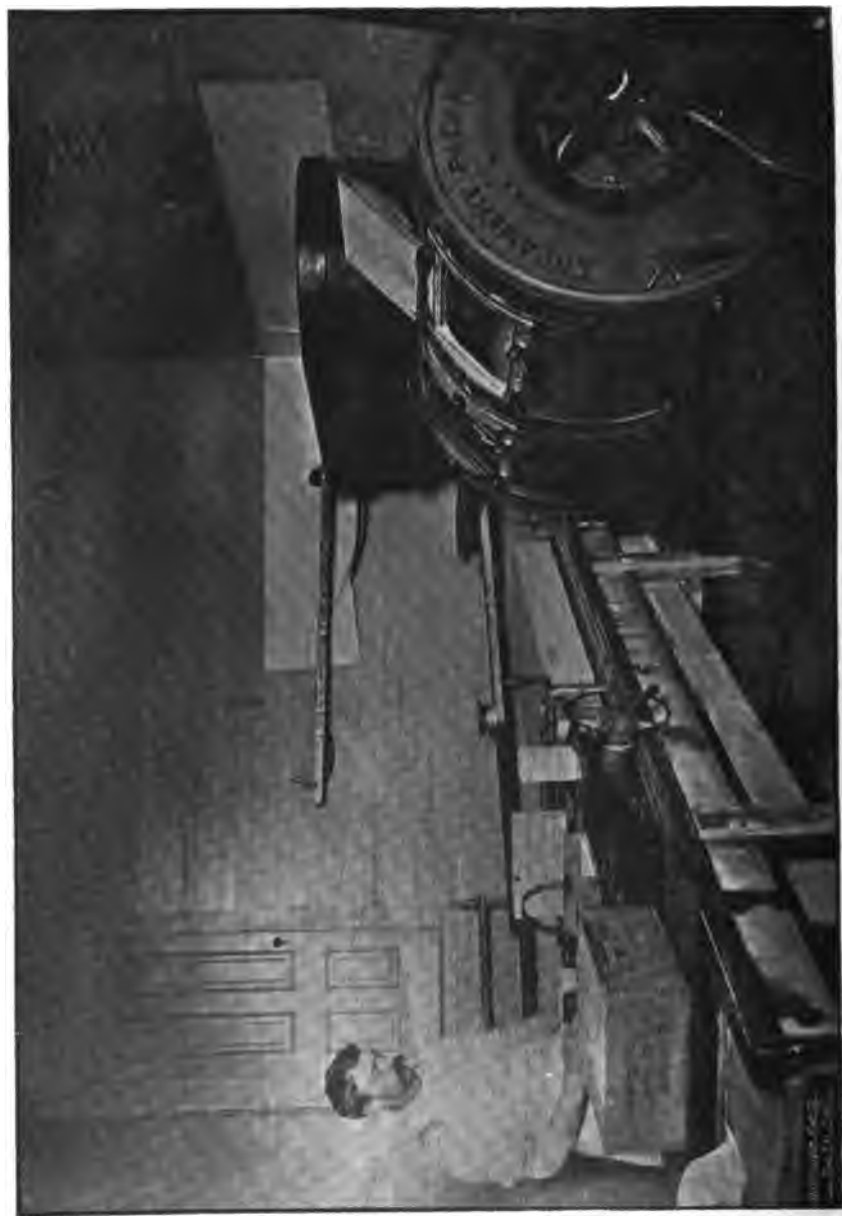
In estimating the cost of equipping a creamery or cheese factory, it should be remembered that the estimate furnished by the dairy supply house does not cover the entire cost. To this estimate must be added freight from shipping point to destination, cost of setting up the apparatus, plumbing, etc., which items will usually add an extra hundred or more dollars to the supply firm's estimate.

CREAMERY ACCOUNTING.

At many of the factories visited the matter of keeping the accounts of the concern was found to be quite a problem. At the proprietary factories the accountant, owner, and buttermaker were usually all one and the same person. The co-operative and stock companies usually have a secretary who keeps the accounts of the factory, but in some cases, as at Albany, the buttermaker is also secretary and general manager. Some of the proprietary factory accounts were in such shape that only estimates could be made of the amount of business for the year. Accounts were made up for each month but no permanent record made. It is needless to say that such factories were not among the most prosperous in the state. At other factories the accounts were so kept as to furnish an accurate and permanent record of the business, but in such a manner as to involve much more labor than was necessary. Several of these accountants said they meant to keep their records in a better and simpler shape in the future, and others asked for information which would lessen the labor of keeping the records. It is with the hope of dropping some suggestions which will be of benefit to those who are not fully satisfied with their method of keeping creamery accounts that this article is written.

Milk Sheets.—The first point to receive consideration is the daily record of milk or cream received at the factory. For this purpose there is probably nothing better than the standard milk sheets which can be secured from any dairy supply house or ruled by the creamery operator himself. These sheets consist of vertical and





Molding Apparatus and Combined Churn, Albany Creamery.

horizontal rulings. On the extreme left is a column for each patron's number, then a column for his name, followed by columns for each day in the month. Each vertical column thus gives, when added, the amount of milk received on that day. The horizontal rulings simply serve as guide lines. These sheets are usually tacked on the wall convenient to the weigh can, and as soon as a patron's milk is weighed the amount is set down in the proper place on the milk sheet. Some factories prefer to use a cheap blank book properly ruled instead of the milk sheet. Should the factory make payments twice a month the milk sheet is usually ruled for a half month only.

Milk Receipt Book.—The milk sheet being only a monthly record, the next point to be considered is the "milk receipt book" or "milk book," as it is often called. This is in all essentials a copy of the milk sheets with three additional columns for Total Milk, Test, and Pounds Fat. If it is the practice of the creamery to test twice each month three additional columns will be required in the middle of the page for the items just enumerated. If the blank book already mentioned is used instead of the milk sheet, and care is taken to prevent it becoming badly soiled, the milk receipt book may be dispensed with. The milk sheets always become so badly soiled by the end of the month that it would be highly undesirable to use them for a permanent record, hence the need for the milk receipt book. The milk receipt book, when all totals are properly made, shows at a glance the amount of milk received on any day, the total amount of milk and butter fat delivered by each patron during the month, and the total amount of milk and butter fat received by the creamery during the month.

The Day Book.—In the day book may be recorded any data not otherwise provided for. In most creameries the sales of butter to patrons will make up the larger part of the entries in the day book, but any local sales should also be entered in this book. Cash sales should properly be entered in the Cash Book, which is a record of cash received or paid out, but such sales should also appear in the day book. In each entry, the date, name of purchaser, rate, amount purchased, and the amount in dollars and cents should be plainly given. Each sale or other transaction is entered as soon as made. The professional book keeper posts in his ledger at the end of each day's business, the entries in his day book for that day. But busy creamery operators have found that they can keep accurate accounts

with their patrons without the use of ledger accounts, and many well regulated creameries keep no ledger accounts whatever. By the use of the milk receipt book, the cash book, the shipping book, the day book, and the monthly pay roll (to be described later), the necessity for ledger accounts is done away with. Let the record of sales be made in the day book from day to day. When the time comes for closing the books and dividing the receipts, which time is usually the end of the month, the day book is opened and the billing of the sales begun. Each name that appears calls for a separate bill. As often as a name repeats itself take up the bill head first used for that name and bill the item at hand, checking off each item as billed. When the end of the month's business is reached each patron's bill will be complete except the totals. These are quickly made and the amount entered in the pay roll and the bills kept in the same order as the names appear on it. When the patron receives his check, he notices the amount of his charges and if uncertain about the correctness, may be shown the itemized bill. Or the bills may be made in duplicate and one copy furnished to the patron with his check while the other is retained by the creamery and filed away with the monthly records.

Shipping Book.—With the exception of a very small per cent the product of creameries and cheese factories is shipped to some distant market and a record of all shipments should be kept. This record should show the date, name and address of consignee, number of boxes or tubs, and weight at the factory. When the returns are made there should be added to the record made at the time of shipment the following: Consignee's weight, price per pound, proceeds, commission, freight and drayage, and net proceeds. A properly ruled page will permit of all these items appearing on a single line for each shipment.

The Pay Roll.—When returns have been received for all shipments, and all other sales properly settled, the total operating expenses are deducted from the gross receipts for the month, and the amount thus obtained is divided by the total number of pounds of butter fat received during the month. This gives the price to be paid for the butter fat, and from the milk receipt book is taken the number of pounds of milk and butter fat. From this data and the bills taken from the day book the pay roll is easily made up. The purpose of the pay roll is to present in condensed form to the person receiving his check, the important facts concerning his relations

with the creamery during the month. The pounds of milk, the test, the pounds of fat, the price per pound for fat, gross amount due, charges due for butter, and net amount due are plainly given. A space is also provided for the signature of the person to whom payment is made. When the payee receives his check, he signs his name as a receipt for it, and has before him a statement of the amount of milk and butter fat which produced it. The pay roll also forms an important record for future use. It may be either in book or sheet form.

Many creameries are in the habit of paying for butter instead of butter fat. To make the pay roll on the next page suited to this plan the only change necessary would be the insertion of a column for *Pounds of Butter* between the two columns headed *Pounds of Fat*, and *Price*. The price would then be for butter instead of butter fat.

This system of keeping creamery accounts is very ably discussed in a book entitled *Creamery Accounting*, edited and published by J. A. Vye, St. Anthony Park, Minn. Practically the same system has been used by Mr. E. J. Seely at the Albany Creamery for about four years. Several other creameries in the state use some features of the pay roll in making up their monthly statements which are posted for the inspection of all patrons.

This form of pay roll, adapted to the July, 1899, business of the Tillamook Dairy Association, would be as follows for the first twenty patrons on the list:

Pay Roll of the Tillamook Dairy Association.

For the month ending July 31, 1899.

No.	Patron.	Lbs. Milk.	Test.	Lbs. Butter Fat.	Price.	Amount	Charges	Cash.	Rec'd Payment.
1	A. Marolf.	42,975	3.875	1,655	\$ 21½	\$357.97	\$ 4.00	\$ 353.97	A. Marolf.
2	H. F. Goodspeed.	27,655	3.725	1,030	"	221.45	2.80	218.65	H. F. Goodspeed.
3	G. Hanenkrat.	28,496	3.825	1,090	"	234.35	3.20	231.15	G. Hanenkrat.
4	J. S. Diehl.	14,084	3.425	482	"	103.63	5.60	98.03	J. S. Diehl.
5	F. M. Trout.	14,365	3.85	553	"	118.90	5.60	113.30	F. M. Trout.
6	L. D. Ackley.	10,861	4.25	462	"	99.33	3.60	95.73	L. D. Ackley.
7	F. Severance.	6,697	4.425	296	"	63.64	6.40	57.24	F. Severance.
8	Wm. Tinnerstet.	5,108	3.925	200	"	43.00	1.60	41.40	Wm. Tinnerstet.
9	F. Maurer.	8,621	3.525	304	"	65.36	.....	65.36	F. Maurer.
10	D. Curtis.	5,825	4.025	234	"	50.31	2.00	48.31	D. Curtis.
11	L. S. Maynard.	823	3.7	30	"	6.45	4.40	2.05	L. S. Maynard.
12	Etta Higginbotham.	4,894	3.8	186	"	39.99	2.80	37.19	Etta Higginbotham
13	J. W. Maxwell.	10,034	4.15	416	"	89.44	3.20	86.24	J. W. Maxwell.
14	G. T. Jenkins.	7,351	3.775	278	"	59.77	2.00	57.77	G. T. Jenkins.
15	H. F. Holden.	17,785	3.725	662	"	142.23	2.80	139.43	H. F. Holden.
16	S. Morton.	2,666	4.45	119	"	25.58	.....	25.58	S. Morton.
17	N. Babi.	3,871	4.025	156	"	33.54	.....	33.54	N. Babi.
18	H. Leach.	8,504	3.975	338	"	72.67	4.80	67.87	H. Leach.
19	A. Carlson.	6,477	4.125	267	"	57.40	2.00	55.40	A. Carlson.
20	C. Kunze	14,599	3.675	537	"	115.45	2.40	113.05	C. Kunze.

DIRECTIONS FOR OPERATING THE BABCOCK TEST.

Issued by D. H. Burrell & Co., Manufacturers of "Facile" Testers, Little Falls, N. Y.

The Babcock Test is a method of determining accurately the percentage of butter fat in milk or milk products, such as cream, skim milk, buttermilk, etc. It was devised by Prof. S. M. Babcock of the University of Wisconsin, and is now recognized throughout the world as the most thorough and accurate system of testing milk.

The test consists in putting a definite quantity of milk (17.6 c. c.) in the test bottle, adding a fixed quantity (17.5 c. c.) of sulphuric acid of proper strength to the milk, for the purpose of dissolving all of the solids except the butter fat, then placing the bottles containing the mixture of acid and milk in the centrifugal machine for the purpose of making a separation of the fat from the liquid. The test bottles are graduated so that the spaces in the neck bear a definite relation to the pipette full of milk, and in this way the percentage of fat contained in the milk can be read directly from the graduations on the test bottles.

An unexperienced person, before attempting to make the test should read the following directions carefully:

Sampling the Milk.—Be careful that the sample represents a fair average of the milk to be tested. Any cream that may have risen on the milk should be thoroughly mixed in with the milk by stirring. Pouring the milk back and forth from one vessel to another is an excellent way of mixing fresh milk when no cream has risen on same.

The best results will be obtained by having the samples of milk and also the acid at a temperature of 60° Fahrenheit.

Measuring the Milk.—This is done with the milk pipette which holds, when filled to the mark on the stem, 17.6 c. c. The milk is sucked up into the pipette above the mark and the finger quickly placed on the upper end of the pipette, and pressed firmly to keep the milk from running out of the pipette. The pipette is then held vertically, with the mark on a level with the eye and by gently relaxing the pressure of the finger on the end of the pipette, thus admitting air slowly, the milk is allowed to slowly flow out of the pipette until the top of the column of milk is level with the mark on the pipette. The pipette then holds 17.6 c. c. of milk.

Filling the Test Bottles.—Place the point of the pipette in the test bottle, holding both the test bottle and the pipette in a slightly inclined position. By removing the finger from the end of the pipette the milk will flow out of the pipette and into the test bottle. The object of inclining the test bottle and pipette is to allow the milk to run down the *side* of the neck of the test bottle thus allowing an exit for the air in the test bottle. If this little precaution is not observed, the air will bubble out and cause some of the milk to overflow. Allow the pipette to drain into the test bottle and blow into the upper end of the pipette to discharge the last drop of milk into the test bottle.

Adding the Acid.—After the milk has been measured into the test bottles, the acid should be added. This may be done at once or the milk may be allowed to stand in the test bottle for a number of days without changing the result. Fill the acid measure up to the mark (17.5 c. c.) with sulphuric acid of specific gravity between 1.82 and 1.83 at 60° Fahrenheit. To pour the acid into the test bottles, the latter should be held in an inclined position so that the acid will flow down the sides of the test bottle and not drop through the body of the milk in the bottle.

By observing this precaution, charring of the milk is avoided and also spilling out of the acid. If the acid has been properly added there will be two distinct layers of acid and milk in the test bottle, without any black layer of partially mixed acid and milk between them. It also prevents any charring of the fat and black specks appearing in the final reading.

Mixing the Milk and Acid.—This is done by giving the test bottles a combined rotary and shaking motion, being careful not to allow any curd to get into the necks of the bottles. The shaking of the bottles should be continued until all the particles or clots of curd are entirely dissolved. The liquid will then be of a dark brown color and of a high temperature, due to the chemical action of the acid on the milk. The object of adding the acid is to dissolve all the solids in the milk, except the fat which is left in suspension in the liquid.

NOTE.—Acid of the proper strength should be used, otherwise the results will not be satisfactory.

CAUTION.—The acid is very corrosive and should not be allowed to get upon the person or clothing. If any should be spilled on the skin or clothing, it should be quickly washed off with water. Color

can be restored to clothing by treating the spots with ammonia water.

Whirling the Bottles.—The test bottles with the milk and acid properly mixed are now placed in the tester or centrifugal machine. The bottles should be arranged in pairs at opposite sides of the center, so that they will balance when rotating. It is better to put the bottles into the tester directly after mixing the milk and acid, while the bottles are hot. If, however, this should not be convenient, the bottles may be allowed to stand an indefinite period, but when they are placed in the machine, means should be provided for heating the bottles while rotating so as to keep the fat in a melted condition. This is done in the steam machine by turning on the steam jet provided for that purpose, or in the hand machine by placing boiling hot water into the bottom of the tester and putting on the cover at once to retain the steam. In the Facile Steam Tester the requisite speed is from 1000 to 1100 revolutions per minute, and in the Facile Hand Testers 100 revolutions of the crank per minute will give 1500 revolutions of the bottles per minute, which is ample for a good separation. The bottles should be whirled for *Five* minutes and then the machine allowed to slow down for the purpose of *adding the hot water*.

The object of adding the hot water is to bring the fat up into the graduated portion of the neck where it can be measured. Boiling hot water should be used and run into the test bottles by means of the pipette, or from a tin pail with rubber tube and pinch cock attached. Care should be taken to add the water gradually so as not to overflow the fat. Enough hot water is added to bring the column of fat within the graduated part of the neck. When all the bottles have been thus treated, the cover is replaced on the machine and the bottles are whirled a second time for *one* minute. The fat as it rises through the hot water is cleared in appearance and if the test is properly made there should be a nice clear column of fat in the necks of the bottles. Perfectly clear readings can be insured by adding the hot water in two instalments; first adding enough to bring the fat into the contracted part of the bottle at the lower end of the neck. The bottles are then whirled for a minute, stopped and hot water again added to bring the fat into the graduated part of the neck. With this method a beautifully clear reading should result with a layer of clear water below the fat. If the reading or fat is at all cloudy add a little hot water and whirl again.

Reading the Test.—The fat, if the bottles have been kept at a

proper temperature, will be liquid and be level or right angled to the neck of the bottle at the ends of the fat column. To read the per cent. fat, hold the bottle up with the fat off a level with the eye and read the graduations at each end of the column of fat. Each small division represents two-tenths of one per cent. fat and the large spaces numbered 1, 2, 3, etc., to 10, represent each, one per cent. fat. By subtracting these readings the per centage of fat is obtained. Thus if the top of the fat column is at 7.4 and the bottom at 2.6, the readings $7.4 - 2.6 = 4.8$ per cent. fat, which means that in 100 lbs. of milk there is 4.8 lbs. fat. The fat can also be read by observing how many spaces the column of fat covers. Thus, if it should cover 3 large divisions, for instance, from the 2 mark to the 5 mark, and two small divisions above the 5 mark and one small division below the 2 mark, the reading would be three large spaces (3 per cent.) plus three small spaces (each 0.2) or 3.6 per cent. in all. By getting the length of the fat column with a pair of small dividers, then placing the lower point of the dividers on the 0 of the scale, the upper point will give the reading direct.

Owing to the small percentage of fat in skim milk a special bottle is recommended to be used. This bottle gives readings down to *one hundredth*, each space representing five hundredths or one-twentieth of one per cent. fat. The same pipette and acid measure are used and the test made in the same way as for milk except that sometimes it is desirable to use a trifle more acid, filling the acid measure $\frac{1}{4}$ to $\frac{1}{2}$ inch above the mark.

Testing Cream.—For this purpose a special cream bottle should be used having a wide neck or a bulb in the neck so that as high as 30 or 40 per cent. fat may be contained in the neck. An 18 c. c. pipette should be used instead of 17.6 c. c. as cream is lighter than milk. Cream can also be tested in the ordinary test bottles in either of two ways: (1) By using a small sized pipette, or (2) by distributing the regular pipetteful in several bottles and adding the results.

In using a fractional pipette such as $\frac{1}{3}$ size or 5.9 c. c., great care should be taken to take a representative sample of the cream. After pouring the pipetteful of cream into the test bottle, the pipette should be rinsed by filling with water and emptying same into the test bottle. With the $\frac{1}{3}$ size pipette, 1 pipette of cream and two of water are put into each bottle. The result should be multiplied by three. Thus if the cream reads 6.4 per cent. the real fat content is

6.4x3 =19.2 per cent. fat. When the regular size pipette is used the cream is distributed in several bottles and water added to each bottle to make in all a pipetteful of liquid in each. The readings are then added. The same acid measure is used and the test made in the same way as for milk.

Composite Tests.—This plan is largely followed in creameries and cheese factories to avoid the labor of making daily tests. A pint jar is provided for each patron and into these are put each day a small sample of the patron's milk with a little preservative added; at the end of each week, or sometimes two weeks, the test is made and the reading represents the average percentage of fat for the period. NOTE.—This is exactly correct only when each patron brings the same amount of milk each day, or nearly so.

Washing the Test Bottles.—This is done most easily if the bottles are emptied directly after making the test and while hot. They should be given a rotary motion which allows air to enter and empties them quicker besides carrying off the sediment in the bottom of the bottles. Then rinse with hot lye water, followed by clean hot water.

The Milk Testing Machine.—To get accurate results the tester should run smoothly, without jar and at a sufficient speed. The bottles should preferably take a horizontal position when rotating.

BABCOCK TEST BLANK.

Corvallis, Oregon,.....1901.

OREGON AGRICULTURAL COLLEGE.

[illegible]

NOTES.

Milk Production.—An attempt was made by the writer to secure information from milk producers regarding their methods of feeding, and the amount of milk produced per cow. Blank forms were sent out through the creamery and cheese factory operators to about one thousand patrons. *Twenty* of these blanks were filled out and returned to the writer. One-fourth of the number fed no grain or mill feed. In this class the estimated butter yield per cow was 137 pounds for the herd making the lowest average, and 245 pounds for the herd making the highest average. Among those producers using mill feed the amount fed ranged from 5 to 12 pounds per cow per day and was fed from 3 to 12 months. This class of producers reported an estimated butter yield per cow of 145 pounds for the herd having the lowest average, and 385 pounds for the herd having the highest. Only six out of the fifteen herds showed an average above 200 pounds per cow, and only one an average above 300 pounds. But there are many good herds in the state not included in the number reporting. The writer knows of one herd of nine cows which produce an average of 426 pounds of butter per cow during the year 1899. The estimated butter is computed from the actual amount of milk delivered at the creamery, and the per cent of butter fat it contained.

Cream Separators.—The 71 factories visited were found to contain 57 cream separators of various makes as follows: 33 "Alpha" De Laval; 13 Sharples; 5 United States; 5 Ried; 1 Empire. Of the De Laval machines, 8 were turbine, and 25 belt. The Sharples machines were, 4 belt, 8 "Russian" turbine, and 1 Tubular. No factory had more than two separators in use, and but four were using more than one. Many of the factories where cheese is made have no separator, and the same is true of the gathered cream butter factories. One factory recently sold two separators, as a large number of its patrons had secured hand separators, and sent cream only to the factory, thereby making it necessary to use but one separator at the creamery.

Churns.—The combined churn and worker has but recently been introduced into the Oregon creameries. Two styles were found in use, viz: the "Disbrow," and the "Squeezer," there being 3 of the former and 5 of the latter. The operators are very well pleased with the machines, claiming that they save labor, space, and pro-

duce butter of the best quality. The churn in general use is the rectangular one without any inside fixtures, there being two general styles, known as the "trunk" and "box" churns. The trunk churns are considerably more numerous than the box style. These churns range in capacity from 100 to 500 gallons.

Babcock Testers.—It has been stated already that every creamery and cheese factory in the state uses the Babcock Test, and these machines represent nearly every manufacturing concern which turns out Babcock testers. They range from 4 bottle machines to 32 bottles. Nearly one-half are turbines, that is, driven by direct steam pressure, and there are two or three of the modified form known as the "Russian." Most of the new machines are known as the "Facile," and "Ideal." These use the regulation Babcock glassware, the framework and cover being of cast iron, thus making a very durable and smooth running machine. With the exception of a very few belted machines, those not of the turbine pattern are driven by hand.

Water Supply.—Fourteen factories report the use of spring water, and ten use city water, the balance using well water. As a rule the well water of western Oregon is of a very excellent quality, being almost wholly free from mineral matter, and obtainable at a depth of 30 to 50 feet. The spring water is also of most excellent quality, but the fact that in many cases it must be piped for a considerable distance, often causes it to become unsuitable for butter-making purposes in warm weather, owing to its high temperature.

Molding Apparatus.—During the year 1900 some Oregon creamery butter was packed in the regular butter-tub or firkin. Prior to that year practically all of it was put up in "squares" or "rolls." These "rolls" are about $6\frac{1}{2}$ x 3 x 3 inches and are supposed to weigh two pounds, but they often fall short, sometimes as much as three ounces. To get butter into this form three general types of molding apparatus are in use. Where considerable quantities of butter are handled the best type is what is known as the Jumbo Butter Molder, shown in the cut following page 40. The Simpson Butter Cutter is also used, and consists of a square box of the proper size to hold 25 or 36 rolls standing on end. The box is packed full of butter, and allowed to harden. It is then cut into "rolls" by means of a frame of fine, tightly stretched wires. Many factories handle considerable quantities of butter by means of the hand mold with which each roll is molded separately. By whatever means the roll is formed it is almost universally wrapped in parchment paper. Formerly it

was the usual practice to wrap but one end of the roll, the unwrapped end being uppermost in the shipping box, and bearing the stamp of the creamery at which it was made. Now many commission men prefer to have both ends wrapped and the creamery stamp printed on the parchment wrapper.

Fuel.—The Gresham Cheese Factory reports the use of coal for fuel. Two other factories use both wood and coal, but all others, both butter and cheese factories, use wood only. The cost of fuel varies considerable, some factories being located near saw mills getting their wood very cheaply while others have to pay as much as \$3.50 per cord. The yearly cost of fuel as reported by the list of factories visited ranged from \$30 to \$250.

Markets.—Practically all the butter and cheese made in Coos county is shipped to San Francisco. A portion of the Tillamook cheese also goes to the San Francisco market. The rest of the factory butter and cheese not used to supply local trade is practically all shipped to Portland, Ore. Rail shipments of butter go by express, there being no refrigerated freight cars used for handling butter. A very liberal rate is made on butter by the Wells-Fargo Express Co.

Cleansing Babcock Test Bottles.—Mr. D. Perozzi of the Ashland creamery had the cleanest test bottles seen in any of the factories visited. His method of cleansing is as follows: Empty the bottles of the milk and acid mixture; submerge in water at 180° for 12 to 15 minutes; empty and fill half full with the cleansing mixture, made up of equal parts of whiting and ammonia, and half as much powdered borax. Use after each test.

(NOTE.—The plate from which was made the illustration following page 28 was loaned to the writer by The Pacific Homestead, Salem, Ore.)

5000.

Bulletin No. 66.

June, 1901.

OREGON AGRICULTURAL EXPERIMENT STATION,

CORVALLIS, OREGON.

THE GRAPE IN OREGON.

PART I.

WESTERN OREGON.

E. R. LAKE.

The Bulletins of this Station are sent Free to all Residents of Oregon who request them.

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THE GRAPE IN OREGON.

PART I.

Western Oregon.

"In the desert it ranks next the pine."—*London*.

The grape has been grown as a fruit for home use in this region for a period of over fifty years. The first vine planted so far as known was an Isabella, in 1848.* Yet, while the grape has been grown here over half a century, it is only within the past sixteen years that it has been considered as a commercial crop. Within this later period several small vineyards of the American type of grape have been planted, and the owners are finding them profitable investments. It is not the purpose of the writer, however, to urge the growing of the grape as a commercial crop at this time, but rather to endeavor to encourage the planting of it for home consumption. That the grape is one of the most healthful of the cultivated fruits, is attested by the fact that the consumption of this fruit has been, from Biblical times to the present, endorsed and prescribed as a dietary food by eminent physicians; the vine and its fruit have also been the recipient of zealous attention by man, and at his hands have been wonderfully developed and ameliorated. While the world at large is most familiar with the history of the European grape (*Vitis vinifera*) the history of the development of the American grape (*Vitis labrusca*, and other species), which is at present receiving much attention by specialists, is even more interesting to the American horticulturist than that of its old world congener, for the reason that, except for parts of California, Oregon, Washington and Idaho, and as a special type for indoor culture, the European variety is not suitable to American climatic conditions.

That the grape is highly esteemed by man is particularly evidenced by the great number of varieties that have been brought out by selection and hybridization. In 1768 Miller described eighteen varieties; in 1875, Hogg in his "Fruit Manual" listed one hundred and forty-three; in 1881, a Frenchman, M. Andre, catalogued four

*Of the Henderson Lewelling collection brought across the plains in 1847.

hundred and seventeen. These are lists of foreign authors.* In our own country there have been listed upwards of fifteen hundred† varieties of our native species, and the list is steadily increasing year by year. And yet with all this array of named and fully described varieties it has been found that only a few are really worthy of being planted in western Oregon for either home or market purposes. Those varieties which the experience of the past ten or twelve years, in particular, have shown to be especially suited to the conditions of western Oregon, as Concord, Worden, Moore (Moore's Early), Diamond (Moore's Diamond), Niagara, and Isabella are all varieties developed from *Vitis labrusca*;‡ while Deleware, which also does well in many localities, is a variety of *Vitis æstivalis*.§ Of the above varieties Isabella is the one planted by the pioneers and first settlers. There is scarcely a locality in which one can not find this variety growing, and among the "old homes" it is safe to say that at least ninety per cent of them have, among the plants in their fruit gardens, one or more vines of the Isabella; and though it occasionally fails to yield a full crop, often bears imperfect clusters, and is troubled with mildew, it is still highly prized by the family, especially for the making of jelly. In general it has received no more attention than the orchard trees and other fruit-bearing plants about the home grounds. A tree, fence, barn or other outbuilding too often is its support and on these it climbs and trails from year to year;|| in few instances has it received the much needed annual cutting back, and in most cases even the building of a trellis has not been sufficient to awaken the owner to the importance of liberal pruning.** With the recent planting of better varieties and the cultivation of small vineyards by men specially interested in this fruit, a very noticeable change in the appearance of the pioneer vines of Isabella has taken place.

Noting the effect of liberal pruning, proper trellising and the thinning out of surplus wood in the summer, many of the owners of old vines, some of which are reputed to have borne hundreds of pounds of fruit in favorable past years, and which formerly trailed

* Barron, 1900.

† W. K. Newell, Oregon Report, 1899.

‡ *Vitis labrusca*, L., is the common wild fox grape of the extreme eastern United States. It is the parent of the best part of the American varieties and is well known through its offspring, Concord, Worden, Diamond, Isabella, Moore, Niagara and many others.

§ *Vitis æstivalis*, Mich., is the Pigeon or Summer grape. Its home is the southeastern part of the country and westward to the Mississippi and Missouri. It is the parent of many of our American varieties as Eumelan, Deleware.

|| See "The oldest vine in Lane county."

** See "The neglected home vine."

unpruned over old buildings, fences, and trees, have removed the surplus wood, placed the vines upon suitable trellises, and are now giving them such treatment as our best growers recommend, with results that are very gratifying to themselves. Though the Isabella is no longer considered a desirable variety for table purposes by our specialists and the dealers, it is still worthy of some attention by the rural home-builder. It is especially hardy, quite vigorous and usually supplies, with a minimum amount of care, a fairly good crop of palatable fruit, more of which should be eaten by our people. It is an excellent variety for jelly-making, and grape jelly rates very high in the estimation of the American housewife; it is likewise one of the best varieties from which to make grape-must, i. e., unfermented grape juice, for which there is a steadily growing demand in one form or another.*

Though the progressive grape-grower of to-day would not recommend the planting of this variety for general home or market use, it were better that those who have vines of this variety growing on their property give them the best of care and thus obtain a quantity of fairly good fruit than to destroy them before others and better varieties have been tested and become productive. By using care it is not necessary even to destroy the root system of the old vine that has become established, but it may be grafted with a better variety, in just the same manner that one would graft a tree, with this difference: the main stem of the vine should be cut off at a point three or four inches below the surface of the ground. If the grafts are inserted at this point in the usual manner of cleft-grafting and then the soil placed back over the wound little difficulty will be experienced in transforming the head of an old Isabella or other undesirable variety into one of more favorable qualities. This work of grafting should be performed while the vine is still dormant.

SOIL AND LOCATION.

Barron,† an English authority upon the grape, writing upon this topic says: "The vine is a plant which is found growing with extraordinary vigor under very opposite conditions and in soils of absolutely different composition. The physical condition of the soil is very much more important than the elements of which it is composed."

* The reader interested in this product of the grape is referred to bulletin 130, California.

† Vines and Vine Culture, 1900.

Phillip Miller, an English horticultural authority, writing upon this subject in 1768 made this statement: "An ideal soil for the grape is a light, loose, brownish sand, with coarse gravel, and at a depth of twenty feet, water."*

The experience of fifty years in western Oregon has confirmed both of these views in so far as they do not conflict, i. e., as to physical conditions.

Our growers have found that the grape, at its best, delights in a deep, warm, mellow soil, but it is not unyielding in this respect, for it can be grown successfully in nearly all soils, if supplied with ample food substances, and the climatic conditions are such that the blossoms are not injured by frost in the spring or the fruit prevented by a low temperature from ripening in the fall.

As a rule the more successful growers of western Oregon find the fir hill land or the sandy, loamy river bottoms best adapted to profitable grape growing. The heavy clays of the first and second benches are so cold that the fruit develops slowly and is frequently unable to ripen before the fall frosts and wet weather seriously injure it. Vines should be planted in such places as have good air drainage, or in places that are protected against cold air currents by the presence of a considerable body of water.

While our vinyardists generally prefer a south or southwest exposure, there are profitable vineyards with western, eastern and southeastern exposure; and many small plantations for home use have no particular pronounced exposure and yet do well one year with another, when on relatively high well drained ground.

PLANTING.

The easiest and quickest way to get a vine to bearing age and size is to plant good, clean, thrifty, well rooted one year old vines. If the cost of these should deter one, then take cuttings. These can be had, generally, for the asking of any reliable grower. One point should be well watched and that is to plant only the most generally approved varieties. The home grower should not attempt to experiment with varieties in his first plantings. The first endeavor should be to secure a few bearing vines of standard varieties. The work of bringing these to fruitfulness will usually result in awakening interest in the choicer varieties, and in due time one may in-

* Dictionary of Botany.

dulge his taste for experiment by trying a few of the more promising new ones.

One step in the planting of a tree, shrub or vine that needs to be kept constantly in mind is the fact that one is planting a crop that will require years to reach its full development. Accordingly, the best of care should be given to the work of planting. A tree, shrub or vine well planted is half established. A common practice in Bavaria, when planting hops, is to thoroughly pulverize the ground to the depth of thirty to forty inches, and yet this crop is expected to remain only twelve to fourteen years, how much more thoroughly then should the soil be prepared for a crop that is to remain for a period of twenty-five to fifty years or even longer.

VARIETIES.

The first problem that confronts the one who would put out a few grape vines, is as to the varieties. This opens one of the questions upon which a very wide diversity of opinion generally prevails, but fortunately for the beginner, the consensus of opinion of our best growers upon this point, so far as western Oregon is concerned, limits the number of first choice varieties for home use to the following: Moore, Worden, Concord, Diamond, Niagara, Deleware, Isabella, Green Mountain, Brighton. In many localities the Black Hamburg does excellently, and White Chasselas, Red Burgundy, Sweetwater, Black July, Muscatel, Red Mountain, Chasselas Fountainbleu, Muscat and a few others in favored localities and under proper treatment, as in the vicinity of Forest Grove, yield very good crops of choice fruit. It is best under all conditions to consult local growers before planting. Keeping in mind that what may be best for the man who grows grapes as a business may not be the most desirable for the man who would only plant for home use.

The late A. R. Shipley, writing in 1892, said: * "For the farmer who is planting for his own use I would recommend Deleware, Concord, Hartford and Isabella, and perhaps Herbert and Worden." Since that time Worden has developed into a general favorite, while Hartford and Herbert have been eliminated from the home list.

J. H. Reese, writing the same year † named Concord, Deleware, Coloma, Eumelan, Pocklington, Salem, and Miles as varieties succeeding in the vicinity of Newberg, but in a recent letter he writes:

*Oregon Report, 1893.

†Oregon Report, 1893.

"I hope no one has taken the above list as a guide to commercial planting. It was only recommended for home use. Nothing that we have thus far tried has been more satisfactory than Delaware and Coloma. The Concord is a most excellent variety but it is occasionally injured by early fall rains, owing to its lateness. We also find Lady a most excellent table grape but the vine lacks vigor."

August Aufranc gives as the leading varieties for his section, Salem, and as varieties for home and market uses, White Chasselas, Red Burgundy and Concord.

G. W. McReynolds, a successful grower in Lane county, finds Green Mountain and Diamond the best varieties for the higher altitudes, while Rev. D. E. Loveridge, of Eugene, finds that Worden, Concord, Delaware, Niagara, and Diamond are the best for the river bottom lands.

Quoting from some recent remarks by Mr. Loveridge, he says: "The Catawba, a late grape, and one that is highly prized in the east, is our best keeper. It keeps until Christmas and with good care may be kept later, but it only succeeds in favorable spots. To my taste the Diamond is our best grape. When ripe it melts like a lump of sugar in the mouth and is sweet all through."

F. A. Rueter, speaking of the varieties found best for wine purposes, as grown on the hills near Forest Grove, says: "I find Sweetwater, Zinfandel, Burgundy, Black Hamburg, Muscatel, Red Mountain, Chasselas Fountainbleu, Delaware, and Muscat excellent for our purposes."

CULTIVATION.

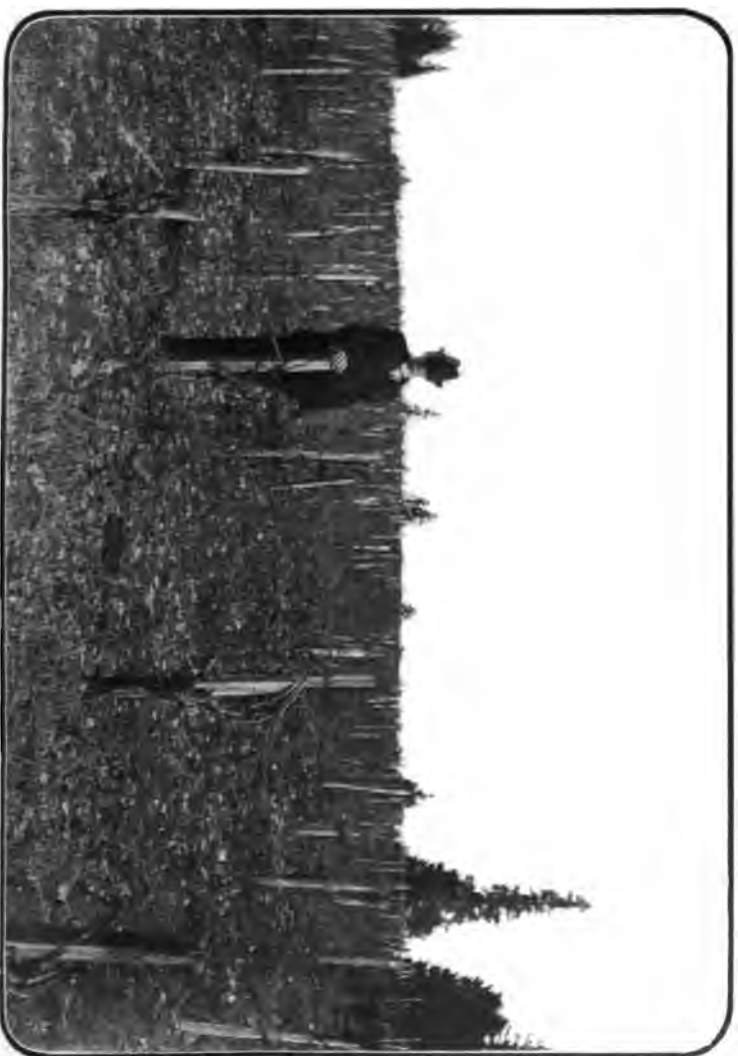
For the first few years after the vines are put out they should receive thorough tillage. Not only should the soil be well plowed and harrowed or dug over in the spring, but it should be frequently stirred, especially during July and August. When the vines have attained the age of ten or twelve years they are quite able to get along without any especial tillage, providing rank growth of other plants is not permitted within a reasonable distance of them. In this matter, such indifferent tillage is only to be tolerated with the home vines. No commercial vineyard could be successfully managed in this manner, and while an easy slipshod manner of tilling cannot be recommended if one would obtain the best results, it were better to have grapes on the home table, obtained from vines partially tilled, than to have no grapes at all.



The Pioneer Grape Vine of Lane County, unpruned for over twenty years.



The neglected home vines.



A stump-trained vineyard at Forest Grove.



The pole trellis system of training.



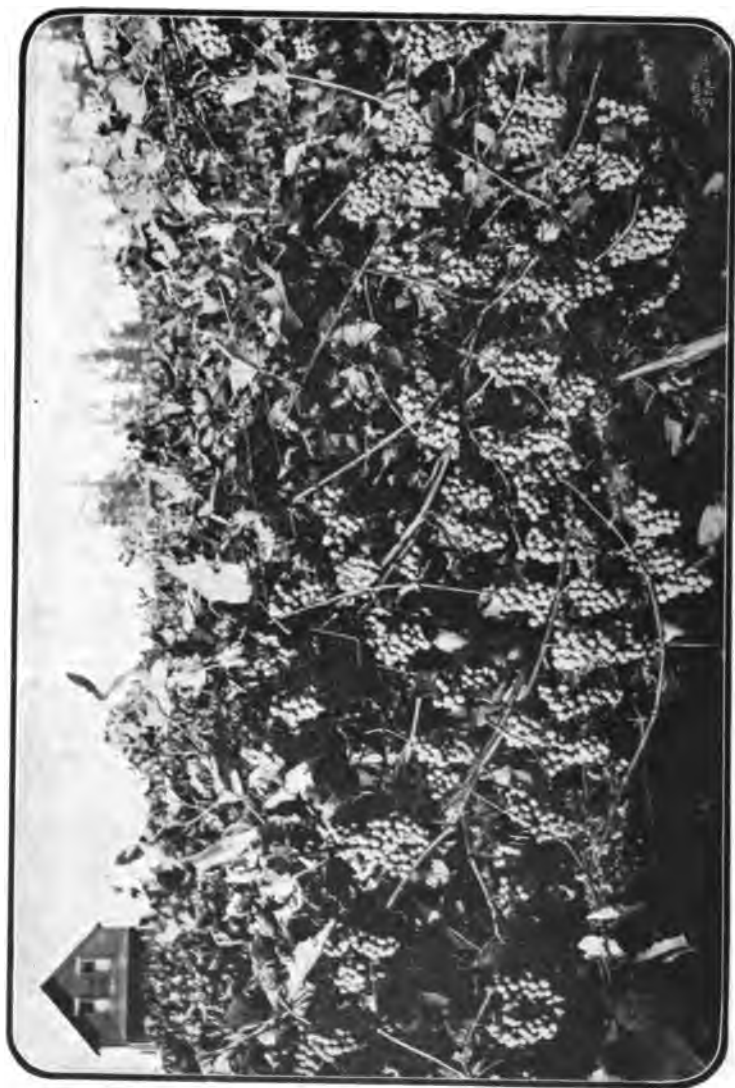
The overhead system of training.



A fruiting Worden vine; fourth year.



A fruiting Concord vine; fourth year.



A fruiting Niagara vine; fourth year.

PRUNING AND TRAINING.

The one persistent feature of growing grapes is pruning. To get satisfactory results from the vine this must not be neglected in the least. There are many styles of training, each adapted to some particular conditions, but with all, liberal and effective pruning must be followed if one is to secure good returns from his plantings. The generally accepted system of training for the American varieties is the trellis, while for the European varieties the stump system is as commonly practiced. In either instance well considered methods of pruning are adopted by the most successful growers. The method of pruning will depend upon the system of training. Undoubtedly for the general home grower the trellis will be the more suitable. This method, while involving a greater original outlay, has the advantage of requiring less after-attention, an important point with the one who grows this fruit as an incidental crop. The details of pruning are fully treated in the separate articles following.

The articles by Messrs. Coolidge, Broetje and Newell have been specially prepared for this bulletin. These men have all been successful growers of the grape and give the benefits of their experience in such a way that the home-builder, and other persons interested in this fruit, may readily grasp the important and essential features of grape culture both for home and commercial purposes. The different localities represented by these writers include the principal sections of western Oregon, in which the grape may be successfully grown.

PESTS.

Like all other cultivated fruits the grape has its enemies, but thus far they cannot be considered serious drawbacks to its culture in Oregon. The powdery mildew appears in nearly every section of western Oregon one year with another, but this is no longer held to be a serious pest and only menaces the crop of the home grower, for the commercial vineyardist duly attends to the work of applying the simple remedies prescribed for this trouble.

While the flowers of sulphur is still used as a remedy against this trouble by many growers, the more progressive commercial vineyardists are recommending the Bordeaux mixture for early applications and the ammoniacal solution for the later applications.

The ease with which the sulphur can be applied, and there being

no compounding necessary, it probably will continue to be used for some time yet by the home grower in preference to the more complex copper solutions. Though if one be provided with a spraying outfit, it will no doubt be better to use the liquid preparations, since the same solution used for mildew on the grape may be used for various other fungous pests.

Lodeman* advises four applications: *First*, about a week before the blossoms open; *Second*, about a week before the blossoms fall; *Third*, two weeks after second application; *Fourth*, sometime between two and four weeks after the third application. Formulæ for making both Bordeaux and ammoniacal solutions are to be found in bulletin 28 of this station.

The effectiveness of the sulphur remedy depends largely upon the temperature at the time at which the application is made. If the weather is warm much better results are had than when rain, or cold cloudy conditions follow. The material should be dusted over both leaves and fruit and the first application may be made when the mildew first appears; the second, in about two weeks, and future applications will depend upon the climatic conditions, and the persistence of the fungus.

Lately, since '98, some growers have reported the trouble known as "rattling" or "shelling." This trouble affects the fruit in such a way that it falls prematurely. In many instances not only is that part of the fruit which falls lost, but the beauty of the cluster being destroyed its market value is reduced and thereby even a greater loss is sustained.

In 1894, Lodeman gave this subject considerable attention and in bulletin 76 of Cornell said: "It would appear that one cause which lies at the bottom of the trouble is defective nourishment, and all influences which aggravate this condition may be considered as indirect or exciting causes." The subject needs further attention before a remedy can be proposed, as the real cause is yet to be ascertained.†

The mongolian, or Denny, pheasant is held by some growers to be as much of a pest in the vineyard as any of the fungi or insects. Being a shrewd bird he manages to secrete himself beneath the foliage and eat and destroy large quantities of the fruit. The damaged clusters often presenting the appearance, to the casual observer,

* Bulletin 76, Cornell.

† Professor Bailey in his "Evolution of Our Native Fruits" makes this statement in connection with a discussion of *Vitis labrusca*. "In its wild state it is very variable in size, color and quality of fruit, and in size of cluster. Its berries tend to fall from the stem, and the "shelling" of grapes in vineyards may be a lingering of this ancestral trait."

of "rattles" cause much loss to the grower of fine fruit. Vigilance and a trusty shotgun would appear to be the only really efficient remedies against this foe of choice fruit.

The robin is likewise credited with doing serious injury to the grape crop, especially in the vicinity of Portland. His case is the more serious, since, in numbers, he greatly outranks the pheasant, and is generally held to be a friend rather than a foe, for the accepted reason that he destroys large numbers of injurious insects, while at the same time there is no inducement to kill him for game purposes as in the case of the pheasant.

VARIETIES ON THE STATION GROUNDS.

The following varieties have been growing on the station farm since 1890. The records show that in all this time, though the vines have grown vigorously, and fruited abundantly, little mature fruit has been harvested:

Allen Hybrid, Amber Queen, August Giant, Agawam.
 Burgundy, Boz, Brighton, Black Malvoisie, Black Hamburg, Black Eagle.
 Concord Muscat, Campbell Early, Caserio Nori, Concord, Catawba, Creveilnor.
 Duchess, Delaware, Dutchfield, Don Juan.
 Eldorado, Eumelan, Excelsior, Early Victor.
 Faith.
 Gross Sapet, Gross Gilliam, Goethe, Green Mountain, Golden Pocklington, Gaertina.
 Hartford Prolific, Herbert.
 Imperial Seedling, Illinois City.
 Jewel, Jefferson.
 (Moore) Diamond, Magora, Muscat, Mamosa, Moyer.
 Nectar, Niagara, Newberg, Naomi.
 Oil noir, Oneida.
 Pocklington, Purity, Peabody, Peerless, Poughkeepsie.
 Rogers Hybrid, Royal Muscadine, Rose of Peru.
 Secretary, Seedling, Salem.
 Ulster Prolific.
 Vergennes.
 Warder, Walter, Wonder, Witt, Worden, Wilding, Woodruff, Wyoming, Wilder.
 Zona.

Comparative notes on several of the American varieties have been made by Professor Coote and are herewith presented.

During the spring of 1890 about seventy varieties were planted. Owing to the poor condition of the soil, the plants made but little

growth the first two years, although they were given good attention in the way of cultivation.

In the winter of 1893 the earth was removed from around each plant for a distance of three feet, to a depth of twelve inches. These trenches were filled up with night soil at the rate of about ten gallons to the vine. After three days the earth was replaced in position, not being again disturbed until spring, when the whole was thoroughly plowed, and the surface soil kept well stirred through the summer. Through the application of the night soil the vines made a growth of fourteen to sixteen feet in 1894, and through a liberal supply of stable manure every other year the vines have made a good development. The location is not a good one, owing to the exposure, which is western and open to the cool sea breezes that spring up during the afternoon and evening. Quite a number of the varieties have never fruited. The following notes were taken during the year 1897:

Allen's Hybrid--Bunches, long, thinly set. Berry, medium, very thin skin, nearly white, being slightly tinged with amber, transparent. Matures in favorable seasons from September 20th to middle of October.

August Giant--Not of any value in this location. Has not matured any fruit during the test.

Black Eagle--Matures from September 26th to the end of October. Bunches, moderately compact and long. Berry, small, black, carries a heavy bloom. Flavor, second quality.

Brighton---A variety requiring a dry period at the time of blossoming in order to insure the setting of the berries owing to the lack of pollen. Berries, medium to large, light red, changing to dark red when fully matured. Not a desirable grape for this location.

Concord Muscat--Matures September 25th. Bunches, long, compact; berry, large, oval; skin, thin; color, a greenish white with delicate bloom; rich and sugary with a strong Muscat flavor.

Concord--An old well known grape. It has not matured well any year. Too well known to need any description.

Deleware Red--Matures September 30th. Bunches, small, compact, shouldered; berry, a little below medium, round; skin, thin; flesh, sweet and tender, rich; color, a light red. It carries a thin bloom.

Eumelan--A very dark red grape. Clusters, medium; berry, medium, covered with a heavy bloom. Matures September 10th.

Early Victor--A dark grape, cluster, medium; berry, small, good flavor, carrying a good bloom. Matures September 8th.

Eldorado--Bunches thinly set with berries above the medium; color, clear golden yellow; bloom, thin; high flavor, resembling that of a pineapple.

Gaertner--Clusters, large, moderately compact; berry, medium to large; color, light red; skin, thin; bloom, thin; flavor pleasant and sweet.

Hartford Prolific—A variety that never fails to mature, generally, from the first to the middle of September. Bunches, medium; color, black. A few days after maturity the berries begin to fall. It might be valuable for home on account of its earliness and for this only, being one of the few early black grapes.

Jewel—Clusters, small; color, dark; flavor, good; matures, September 4th.

Moore Diamond—A light green grape of excellent quality; berry, large, with good heavy bloom; matures September 25th.

Niagara—Matures, last of September. Bunches, compact; berry, medium, with a thin bloom; skin, thick; color, pale green changing to a pale yellow when fully ripe; flavor, very good.

Nectar—Berry, medium to large; color, dark, covered with a heavy bloom. Matures September 2d. Fruit of fair quality.

Moyer—Clusters, small. Berries, small; color, red; of excellent quality. Matures September 3d.

Poughkeepsie—A vigorous variety, very much resembling the Delaware. Matures September 13th. Clusters thickly set with small, very sweet berries of excellent quality. Color, light red; a good second early variety.

Purity—Not of much value on account of its lateness in maturing; bunches, small and loose; color, pale red, with a thin bloom; skin, thin; flesh, coarse.

Secretary—Does not mature. Altogether too late a variety for this section. Bunches, large, moderately compact, well shouldered; berry, large; color, black, with heavy bloom. It has all the appearance of being a good grape in earlier localities.

Salem—Matures the last of September. Clusters, well shouldered. Berry, medium to large; color, pale red, changing to a deeper red in the sun.

Worden—Clusters, large, well shouldered, moderately compact. Color, black; berry, large, slightly acid; skin, thin; bloom, quite heavy. Matures September 20th.

Wyoming—Produces quite small compact clusters; berries, medium; color, red, very much resembling the Delaware, covered with a slight bloom; flesh, firm, sweet, pulpy, a little foxy.

Rogers Hybrid No. 9—Matures September 20th. Clusters, medium to large, sometimes shouldered; berry, medium; color, dark red with a heavy bloom; skin, thin; flesh, pulpy, sweet and altogether rich.

Peerless—A red grape, resembling Black Hamburg in color and shape. Matures September 18th; berries of medium size; flavor not the best. Has all the appearance of being a good grape if placed under better conditions.

The Southern Willamette Valley.*

In order to make the highest success of grape growing three essentials are to be observed: 1st, Selection of variety; 2d, Selection of location, and 3d, Proper handling of the vines while growing and bearing.

Sixteen years ago, when I moved out into the hills south of Eugene, and told some of my farmer friends that I was going to devote one of the choicest spots of my limited area to a vineyard, they tried to dissuade me, at the same time informing me that they had tried grape-growing, and that on account of the cool summers, grapes would never get sweet and only in exceptional seasons could any grapes fit for table use be raised.

The variety generally grown at that time all over the Willamette valley was an Isabella seedling, with an occasional true Isabella, usually planted in the poorest places on the farms and never pruned or cared for. My first step, after preparing a warm sunny spot on the southeast side of a hill, was to procure from a vineyardist in Napa valley, California, plants of his best early grapes of the Vinifera or foreign type, and at the same time secure from an extensive grape grower of western New York plants of his best American varieties. When the vines were three years old not one of my neighbors was so astonished at the large beautiful clusters of delicious grapes—red, white and blue—as myself, and when put on the Eugene market nine out of ten purchasers supposed they were getting California fruit.

The proper way to plant a vineyard is to have the rows run north and south, vines 8 feet apart in the rows, and rows 10 feet apart.

It has been my contention that in certain respects Oregon is the best grape country in America. In California the large foreign grapes, Chasselas, Black Malvoisie, Tokay, Muscat, Black Hamburg, and Cornichon grow to perfection, but on account of soil and climatic conditions our delicious high-flavored American varieties do not reach perfection.

In western New York and along the lake shores in Ohio the finest Worden, Concord, Niagara, Diamond and other leading American varieties reach perfection, but on account of the severity of the winters and fungoid diseases prevalent in those sections, the truly delicious foreign grapes cannot be grown. In this Oregon of ours, side by side, can we grow Worden, Concord or Niagara equal to New York, Ohio or any other state, and to my taste the most delicious of all grapes, Chasselas, Black Hamburg and Black Malvoisie of the foreign varieties. In a few seasons have I succeeded in growing truly delicious Muscats, but, as a rule, Tokay, Muscats and Cornichon do not mature. These latter are black skinned, coarse grapes at best.

*D. W. Coolidge.

At the opening the selection of variety was placed first; possibly location should have been first, as experience has taught me that the foreign varieties do not succeed so well in the valley as on a hill-location. A southeast exposure, protected on the north and west by timber if possible makes an ideal location. The American varieties do equally as well on the hillside as in the valley; but, although I have taken plants of the foreign varieties from my hillside vineyard and planted them in the valley, the quality of the fruit is not nearly so good, and mildew is harder to contend with. Wherever one plants a vineyard, give it the sunniest, warmest spot you have, provided, of course, that the soil is good. While it does not agree with my own taste, the local market shows a decided preference for the American varieties, as Worden, Concord, Niagara, Diamond, Brighton, Diana, Delaware, Catawba, Agawam and Lindley, and I would plant them in the order named. There is not a more delicious American variety than the Worden which has many good points to commend it. It is the earliest American grape; berries and bunch large and of unexcelled flavor. It has some weak points too: it cracks and shells badly and takes the most delicate handling to get it upon the market in prime condition. The vine is quite vigorous but not quite so much so as the Concord or Niagara. I dislike to admit it, after what has already been said about the quality of Oregon grapes, but it is a fact, that the Concord does not attain quite the high degree of excellence that the western New York or Ohio Concord possesses, but the Worden, Niagara, and in fact all other American grapes, really seem quite the equal of the same varieties in the east. As all know, the Worden and Concord are blue grapes, while the Niagara and Diamond are white or green American varieties. The Niagara is a most vigorous growing vine, an enormous bearer and of very good quality if allowed to hang on the vines, ordinarily, until about the middle of October. Diamond is not quite up to my early expectations; the berries are not so large as Niagara, but it is somewhat earlier, and should find a place in every garden. The preference among consumers is for the blue grapes, however, and if one is planting for market he will want more of the blue varieties. The Brighton, Delaware, Diana, Lindley, Agawam and Catawba are all red grapes of truly delicious quality but the poorest sellers of the three colors. The Lindley and Agawam do not perfectly fertilize and are always borne in imperfect clusters. This is also largely true of the Brighton. The Delaware and Diana, both delicious, are too small in berry for the trade, usually. The Catawba is so late that it ripens very imperfectly. These are the best American varieties that have come under my observation; while Moore's Early, Early Ohio, Eaton, Bacchus, Hartford, Wyoming Red, Woodruff Red, Pocklington, Clinton, Wilder, Early Victor and several others that I have tried are so inferior in quality and growth of vine as to make them almost worthless.

My favorites of all grapes grown in the Willamette valley are two

foreign varieties, the Chasselas Neuschatel, a white or green grape of the sweetwater type; but much superior to it in both size of fruit and flavor is the Black Malvoiseie. The former ripens very early on hill locations, usually by September 5 to 10, and the latter about the middle of October. The Malvoiseie is a large blue grape, oval shape, and borne in large clusters. As remarked before, neither one of these reach the same degree of perfection in the valley as on the hillside. Another truly delicious early foreign grape is the Violet Rose. Its name is misleading, however, as it is a white or green grape; oval shaped berry, quite large; and large bunches. One favorable season Violet Rose was picked and the fruit was quite sweet on the 15th of August. It is a grape I obtained of James Varney, late State Inspector of Fruit Pests. This last variety has one serious drawback—it fruits very sparingly, even when an unusual number of buds is left. Black July and Black Catawba will both ripen in ordinary seasons, but they are not desirable in all particulars. It is only an occasional season that Muscat, Tokay or grapes of that class will ripen perfectly in the Willamette valley. I have experimented with many other varieties but have found none worth one's time except the above favorably mentioned ones.

Although one may have the choicest varieties planted in a most favorable location, yet if he fail to properly prune his vines the result will be far from satisfactory. Foreign and American varieties must be pruned radically different to obtain the best results. The foreign varieties should be stumped or trained low, while the American should be trained to a trellis. Both should receive the same treatment the first year, being cut down to about three buds, which are all allowed to start, and when the growth is 4 or 5 inches long all but one sprout should be rubbed or cut off and only the one allowed to grow the first season. If American varieties are planted and the vines have made three or four feet growth, erect a good substantial trellis by planting good cedar posts 16 feet apart in the row; brace the end posts well, and stretch a lower wire, about 18 inches above the ground, tightly on the posts; cut the vine so that it will reach about 2 inches above the wire; tie it securely to the wire as nearly perpendicular as possible. The second year allow only two buds to grow, training them horizontally to the lower wire.

The following spring cut these two arms back to about 3 buds each. At this time stretch the upper wire to the trellis, about 4 feet from the ground. Train the strongest growth straight up to the wire, and one of the strongest growths of the side arms to the wire, allowing the other two buds to grow. The following season leave the two side arms 3 or 4 feet long, cut the two other limbs back to 2 buds, and cut the upright growth about 2 inches above the wire.

The renewal plan of pruning seems to give the best results. This consists in cutting out the old wood each year and training the last year's growth to the trellis. After the third year train side arms on the upper wire as well as the lower.

The foreign grapes need very different pruning. The first year the vine is treated just the same as the American varieties. At the end of the first season's growth plant a substantial stake and cut the vine to a height of 18 inches and tie securely to the stake. The second season allow only 3 buds to grow. The following fall cut the three limbs back to two buds each. Ever after that cut back to one or two buds, and when the vine gets too thick cut out some of the old wood. After the vine is three or four years old it will have formed a substantial stump that will stand alone and the stakes can be removed.

In February, if the weather be good, after the pruning is done, spray the vines thoroughly with a strong Bordeaux mixture. Repeat the spraying with a weaker solution when the grapes are half grown. This is sufficient for American varieties. The foreign sorts will need to have a liberal application of flour of sulphur, about the first of August. This can be sprinkled on the vines by hand, taking care to get the sulphur all over and around the vine. The amateur grower will have to learn by experience whether or not another application of sulphur is needed. He will soon learn to know the first appearance of mildew on the vine or grapes. Right then is the time to begin sulphuring.

The Lower Willamette Valley—East.

When I first came to Portland, I was told, upon inquiry, that grapes could not be grown here and that many unsuccessful efforts had been made. Having brought plants of a few varieties with me from Illinois, I planted them at Mount Tabor, together with other varieties that were obtained here. Some of the varieties proved to be quite a success. With the success of this small planting in view others became interested in the growing of good grapes, and as it had been demonstrated that only our native American grapes could be grown successfully here, I sent east for plants of over thirty varieties, only such as ripen before or with the Concord. With these plants a small vineyard was started near Milwaukie, Clackamas county, in the spring of 1891. Of these varieties some proved to be a decided success, while others were practically failures. Some of these latter varieties ripen from the first to the middle of September while the Concord, Niagara and others ripen about the first of October. This vineyard has been visited by hundreds of people who have expressed astonishment at seeing the vines laden with large perfect clusters of fruit—equal to that grown anywhere in the Middle States. There has not been a failure yet. The vines are strong and healthy, free from mildew or other disease, and free from insect pests, while plants of foreign varieties grown nearby have been entirely ruined by mildew.

In 1898 we began marketing the fruit the first week in September and ended the middle of November. The first part of the crop was sold at wholesale, price, four cents per pound; the remainder, for three cents per pound; none was sold for less, though grapes sold by others for less than these prices. The fruit of our American varieties grown here is much preferred by the people of Portland to that which comes from other sections of the country.

All the varieties of our American type of grapes have come originally from the wild grapes that grow abundantly throughout the middle, northern and southern states, and they are generally divided into four distinct classes.

First. The Northern Fox Grape class, *Vitis labrusca*. It is the varieties of this class upon which the growers of this valley must chiefly rely. To this class belong the Isabella, Catawba, Concord, Worden, Moore's Early,† Eaton, Niagara, Green Mountain, Brighton, Vergennes, Lady Washington, and a great many others.

Second. The Summer Grape class, *Vitis æstivalis*. Only a few of this class are good for the table, but they are valuable for wine. I have only one variety of this class, the Centennial; a dull yellowish white grape; a good bearer; bunches of good size; berries somewhat below medium but sweet and delicious. Though it ripens with the Concord, it can be kept until the new year.

* J. F. Broetje.

† Moore—American Pomological Society nomenclature.

Third. The Riverside Grape class, *Vitis riparia*. I have a few varieties of this class. The Empire State, a white grape that bears well; bunches, long; berry, medium, very sweet. The Elvira, another white grape; wonderfully productive; bunches rather small, good for wine making. Then there are many hybrids among the various classes, some of which are very fine, as the Salem, Lindley, Agawam, Wilder and many others, but these are not so reliable and saleable as the Concord and the Niagara.

Fourth. The Southern Fox Grape class, *Vitis vulpina*. None of this class can be successfully grown in our climate.

Throughout our valley one sees on the sides of buildings, and in gardens many grapevines that always look sick and gray with mildew, except where they are sprayed and sulphured several times during summer. These are the varieties that are grown in California. They are of the foreign type, *Vitis vinifera*, and were originally brought from Europe. They cannot be recommended for planting in this part of the state. I have met many people, who have never thought about the different classes of grapes; their origin, habit and properties, hence this brief outline of the types and classes of the grape. According to my experience, at present, planters in the lower Willamette district, must rely mostly on varieties of the Labrusca class, and only those that have been successfully grown will be named here.

The Concord.* This is the grape for everybody, large strong-shouldered bunches of big, black, sweet berries of the fine native flavor that all Americans like so well. It is very productive and always a sure bearer. Seven year old vines have borne more than thirty pounds each.

The Worden.* A black grape like the Concord; bunches large and heavy; berries larger than the Concord and rather better in quality; ripens about ten days before the Concord and is fully as productive.

The Niagara.* A white grape that bears well and regularly; bunches, very large and heavy; berries, sweet and of good flavor. This variety is gaining much in favor on the home market. It ripens about ten days before the Concord. It is the best of the white grapes.

Moore's Early.† A black grape; bunch medium; berry, very large, quality as good as Concord, but vine not quite so productive. Very valuable here on account of its earliness. It ripens nearly three weeks before the Concord.

Eaton. A very strong grower; bunch, very large and heavy; berries, very large, many an inch in diameter, black and of good quality. It sells well, but will not bear long shipment very well.

Moore's Diamond.‡ A very good white grape; ripens about two weeks before the Concord. Bunch and berry, large and of best quality; not so productive as the Niagara.

*See plate. †Moore, ‡Diamond—American Pomological Society nomenclature.

Green Mountain. A white grape. Rank grower; bears well; bunch, long; berry, medium, very sweet and delicious. It ripens here about the first of September.

Vergennes. A red grape of good quality; bears well and is a good keeper. Bunch and berry, large.

Brighton. A red grape of very best quality. Bunch large; berry, medium, very sweet and fine; keeps well. Ripens the same time as Concord.

Lady Washington. A beautiful large white grape, bears well, but in quality not as good as Niagara.

Wyoming Red. A very handsome grape. Bunch and berry medium of bright red color, sweet with strong native aroma. Ripens two weeks before the Concord. The blossoms do not fertilize well every year, and for this reason it is not a reliable bearer.

Delaware. Though not belonging to this class, it is so well known and succeeds so thoroughly under our conditions that I cannot pass it unnoticed. Bunch and berry, small, light red, very sweet and of most delicious flavor. It is an abundant bearer.

The above varieties have been found to be the best and most profitable for our home market, and they are sufficiently hardy and prolific to be all that the grower can desire of them.

HOW TO PLANT.

The vines should be planted in rows seven feet apart, and eight feet apart in the row. After the ground is well prepared and rows staked off, holes are dug about one and a half to two feet deep and three feet across. These holes are partly filled up again with top soil, in such manner that it forms a little hill in the center of the hole, then the roots of the vine are spread around on this, care being taken to have the vine in the center. After the vine is planted a stake should be driven beside it. During the summer clean and thorough cultivation should be given.

PRUNING AND TRAINING.

In the fall or winter following the first season's growth, all shoots are cut away except one, the strongest. This is cut back from two to four buds. The next summer the strongest shoots should be tied to the stake; the others should be cut away clean. The second winter cut away again all shoots, leaving only one, the strongest. This is cut off at a height of two feet above the ground more or less, according to its strength and size, and tied to a stake or wire, if wires have been stretched. The best and cheapest material for tying the canes to the wires is the shoots of the golden willow. All shoots that issue within a foot to a foot and a half of the ground, should be pinched off as they appear, in order to have a single straight stem and the canes thus be kept a sufficient distance above the ground. It is necessary to have the canes well up from the ground

in order that the air may circulate freely underneath, and this also makes cultivation much easier. Of the shoots that come at the upper end of the cane,* leave three or four. These may be fastened, as soon as long enough, to the upper wire. They must not be checked in their growth. During the third winter two of the strongest canes are cut back, leaving four to seven buds on each, and tied to the upper wire, the other canes are cut back to two buds, these are intended to make bearing canes for the year after. If the vines are rather weak, the canes should be pruned shorter and tied to the lower wire.

In the spring of the third year, after the vines have been plowed and hoed, the young shoots will push out vigorously. Now come the most important and delicate operations to be performed, in the pruning of the vine. This is known as summer pruning, and is usually done with thumb and finger. The work should be commenced when the young shoots are about five or six inches long. One shoot of the spurs† and one shoot at the lower end of the canes must not be touched, because they are wanted for bearing canes next year, all the rest are pinched off at the ends, leaving one leaf above the upper bunch. All the shoots that issue between the spurs and canes, and also all that issue on the stem below, must be rubbed off. Some buds occasionally produce two or three shoots; rub off all but the strongest. Usually the grape will bear three bunches on each shoot. Now suppose a vine was pruned to two canes with seven buds each, and two spurs with two buds each, would make eighteen shoots; and, should each shoot bear three bunches there would be fifty-four bunches in all; this would be too much for one vine except it were very old and strong; therefore, the smallest and poorest bunches are pinched off, leaving only the largest and best. A vine in its third year should not be allowed to bear more than fifteen pounds. If some shoots have not sufficiently developed to be pinched, pass them by and go over the vines again a few days later. This early pinching of the young shoots tends to throw all the vigor of the vine into the development of the fruit clusters and leaves. This early pinching saves much of the strength and vigor of the vine, for otherwise the shoots grow long and hard, and the operation of pruning is more difficult. This operation of pinching the shoots and thinning the fruit results in a larger quantity and better quality of fruit. After blossoming, and the laterals or side shoots have come out from the axils of the leaves, the plants are again gone over and these pinched, leaving one leaf. If the last named laterals shoot out again they should be likewise pinched, leaving one leaf. After this last pinching little growth will be made. The shoots which are left untouched in the operation of pinching and which are designed to bear fruit next season, may be cut off at the ends some time during July or August. It must be

* A cane is a growth of the previous year.

† A spur is a short branch of the original stem, two or more years old.

kept in mind that the fruit should grow and ripen in the shade, and that it is the leaves that feed the fruit and the plant, and that the roots only furnish the water and some mineral matter. Many persons make a mistake in pulling away all the laterals besides many leaves in order, as they believe, that the strength of the vine may be forced into the fruit, and that the rays of the sun may shine on the bunches, and thus help to develop them.

The fourth year. At this age the vines are large and strong enough to bear a full crop. The pruning is the same as that of the third year, but instead of leaving two canes and two spurs, there may now be left three or four canes and as many spurs. Consider the strength of the vine and prune accordingly, longer or shorter, from six to ten buds to a cane. Vines that show lack of vigor may be pruned as in the third year. Care, however, should be taken not to overtax the vines, as they are apt to overbear and lose their vigor. Should the soil be rather poor and the vines look weak, use some stimulants, as potash or bonedust. Never use ordinary stable manure. Soils that produce profitable crops of wheat or potatoes are rich enough for grapes. Grapevines that have been bearing for eight years at Milwaukie have never tasted any fertilizer yet, and the vines are increasing in vigor every year.

THE TRELLIS.

Our grapes are all grown on wire trellis. Strong posts are set firmly into the ground, at the ends of the rows, and well braced. Holes are bored through the end posts two feet above the ground; through these the first wires will be fastened: two feet above the first set of holes bore another set for the top wire. The wires are then stretched tight and fastened at both ends. Then good strong stakes, seven or eight feet long, pointed at one end, are driven firmly into the ground between the vines in the rows. Commencing with the first stake in the center, between the first and second vine, the next stake comes between the second and third, and so on through the row. Place the stakes edgewise, so that a sharp corner faces the wire, then saw a notch about three-fourths of an inch deep, slanting downward for the wire to rest in. These notches must correspond in height with the holes in the end posts. Some use staples to fasten the wires.

The Lower Willamette Valley—West.*

No longer ago than 1898 it was a customary practice for the fruit dealers of Portland to import every fall a few cars of New York grapes. Happily this practice is no longer necessary. A few men have grown grapes in Oregon for many years and with such success that the culture of this fruit is now becoming general; with a full crop this year (1901), we will have grapes for export. Puget Sound and British Columbia still import eastern grapes, thus it is seen that there is a nearby market for us to supply. It is quite probable also, that a considerable trade can be developed in California for our Concord grapes, as this variety is not grown there, nor is there any other variety that will take its place.

In planting a vineyard give first attention to selecting a suitable location. Most any of the hill lands of western Oregon that have a southern or south-western exposure and that are sufficiently high to be free from late spring or early autumn frosts, will do. Elevations between 200 and 1000 feet are best, though lower land near the Willamette river is just as good. A very necessary point to keep in mind when making a selection is that the site shall be such that the cold air can settle to the ravine or valley below; this is a great protection against frost, and also, such land is usually naturally well drained. If the drainage is not naturally good then tile it; for a good friable soil is a necessity in grape culture. Should one have no other suitable place, then plant a few vines against the south side of a building or tight board fence.

PREPARATION AND PLANTING.

For the grape nothing is better than new land or clover sod; plow deeply; harrow thoroughly; then dig holes for each vine, twenty-four to thirty inches in diameter and sixteen to twenty inches deep, putting the surface soil and sod back into the bottom of the hole. Vines should be planted in rows seven or eight feet apart, and eight or ten feet apart in the row. This will require 600 to 800 vines per acre.

The best time for planting is in April, and one year old vines are to be preferred. When planting trim off all ragged or broken roots and cut back long ones one-half to two-thirds, and cut back the stem to two buds. Plant deeply, working fine surface soil carefully about the roots then tread thoroughly with the feet until the hole is nearly full, and finish by spreading the earth from the bottom of the hole loosely over the top. When planted set a strong four-foot stake an inch or so from the stem; always on the same side of the row so that they will not bother when cultivating.

Cultivate thoroughly from early spring until August 1st to 10th. Cultivation after this latter date tends to prevent the proper ripening of the wood. The tools needed are a one-horse plow, a cultivator and a hoe.

PRUNING AND TRAINING.

The pruning the first year is plain sailing but after that it becomes more difficult, and the beginner should, if possible, visit some experienced grower and see how it is done for it is very difficult to write directions sufficiently clear

*W. K. Newell.

for a new hand to follow. As soon as the two buds left at the time of planting, get long enough, tie the strongest one to the stake and rub off the other. Keep the new shoot tied carefully to the stake as it grows and rub off all laterals as fast as they appear. There are many ways of training the vine, but the fan shape on a wire trellis is my preference. If this method is adopted then the second spring the first season's growth must be cut back to twelve or fifteen inches from the ground, leaving the two top buds to grow, and rubbing off all other shoots and suckers as fast as they appear. Treat these two shoots just the same as the one of the first season.

The third spring build trellis. Use heavy cedar posts well braced at the ends and light posts every sixteen feet apart along the row. No. 12 galvanized wire, one twenty-four inches from the ground, the other fifty-two or fifty-four inches should be stretched tight on the posts. Then cut back the two canes of the second season's growth to three or four buds each and tie to the lower wire, still keeping the main stem tied to the stake until strong enough to stand alone. Let two shoots grow from each branch of the vine, tying them to the wires as they grow out; when five or six feet long pinch off the ends. These should bear a few grapes, and will furnish the bearing wood for the next season. The fourth season four or five new shoots may be started for the fifth season's fruit, when the fourth season's canes are removed. This process is repeated each year, remembering, always, that the fruit is produced only on the new wood of the previous season.*

February is the best time for winter pruning; do not prune old wood after sap starts in spring. Summer pruning consists of rubbing off all suckers and superfluous buds and pinching back the shoots at the proper time. The shoots for next season's fruit should be pinched when they have attained a growth of five or six feet, and the bearing shoots (when the fruit has set) should have one leaf left beyond the farthest bunch of fruit. If the vine is setting too much fruit remove some of it. If one does not wish to trellis just keep the main stem tied to the stake and headed down to twenty-eight or thirty inches, allowing bearing shoots to issue directly from it, and heading these shoots back every year to two buds.†

The expense of starting a vineyard is large; and is itemized about as follows: Land \$50.00 per acre; good, deep plowing, \$2.50; harrowing, \$1.00; digging holes, \$15.00; stakes, \$8.00; planting, \$12.00; vines, \$40.50; cultivating, first season, eight times, \$8.00; hoeing, \$3.00; tying and pinching laterals, \$4.00: total for first season, \$143.50 per acre. The second year, winter pruning, \$2.50; cultivating, etc., for season, \$20.00. The third year the trellis will cost \$50.00, pruning, etc., \$25.00, bringing total cost to \$241.00. The vineyard should pay its own way after the third year, and be in full bearing by eight or nine years, when it should produce five tons or more of fruit per acre each year.

WHAT TO PLANT.

Among the best of the varieties that have been thoroughly tested in Oregon, are Concord, Worden, Moore, and Eaton for black grapes; Niagara, Diamond, and Green Mountain for white grapes, and Delaware and Brighton for red grapes. All of these varieties will yield well and ripen perfectly in a favorable season, and cannot fail to give satisfaction, except that Worden will be found too soft for shipment.

Do not attempt to grow such varieties as Black Hamburg, Sweetwater, or Muscat; they are not well adapted to this climate.

* I. e. on shoots which issue from canes of the previous year.

† This is the so-called "stump" system of pruning as practiced in California and also in southern Oregon and at Forest Grove.

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OREGON AGRICULTURAL EXPERIMENT STATION,

CORVALLIS, OREGON.

THE SILO AND SILAGE.

J. WITHYCOMBE.

The Bulletins of this Station are sent Free to all Residents of Oregon who request them.

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The Silo and Silage.

The growing tendency among our agriculturists to give more attention to dairying, brings frequent appeals for information relative to the construction of the silo; suitable crops to be grown for silage and methods of handling the same. Hence this bulletin is prepared more with the view of supplying this want of practical information as to the silo and silage, and less with the purpose of submitting at this time technical conclusions from the limited data at hand.

The success of winter dairying rests largely upon the ability of the farmer to secure a cheap succulent food for the herd. This class of feed will be found in silage or roots. The cost of production, however, is always a dominant factor when feeds are considered. From results of experiments thus far made, but a slight difference is indicated in the feeding value of good silage and roots. Silage is the cheaper food of the two, has the advantage of occupying much less space in storing, and is practically insusceptible to injury from freezing. The crops commonly grown for silage are usually removed when the soil is in a condition to best withstand the tramping and packing resulting from the operations of harvesting. The root crop is seldom ready to be gathered before the usual fall rains set in. The soil at this season is often saturated with water, and not infrequently serious injury to the land results from the horses and implements used in harvesting the crop.

The deeply rooted prejudice against the wholesomeness of silage so prevalent in the past has very largely been obliterated, and to-day it is generally recognized by all intelligent stock feeders as an economical food. The principal objections at present relates to the chemical or biological changes which take place, causing more or less serious loss of nutritive substances, and often resulting in the development of an excessive amount of organic acids. However the nutritive loss of silage in a well constructed silo should not necessarily be greater than the loss incident to the curing process of hay. In fact, when we take into account the almost total loss at times of a clover crop from rain, the silo will easily prove itself to be the

more economical and surer method of preserving early cut forage crops.

The silo has passed the experimental stage, for the economy and practicability of this method of preserving fodder have been fully demonstrated. Domestic farm stock, however, cannot subsist upon silage alone, no more than man can hope to live on bread alone, hence a certain proportion of the farm crops should be cured as hay. One peculiar advantage the silo offers to the farmer is the almost absolute independence of weather conditions during the time of harvesting. In humid climates the loss of hay at times is very large, but with the silo this loss can often be reduced to the minimum. Dairymen experience more losses with clover than with any other hay crop. To prevent this it is suggested that the first cutting of clover, whenever practicable, be put into the silo, and the second cutting, or later maturing forage crops, be utilized as hay. While the silo is an indispensable adjunct to successful dairying, its use should not be confined to dairying alone; for it can be made to contribute equally as valuable service to the general farmer and stock grower. Silage is a valuable food, and is relished by all classes of farm stock, but is more particularly adapted for ruminating animals.

The efforts of the Station in this line of investigation during the past year have taken the direction of practical rather than scientific work. The object sought was to determine, if possible, what variations there are in the acidity of clover silage with clover ensiled at different stages of ripeness; also the effect of water on the preservation of clover silage. For this work four moderate sized stave silos were constructed. Two being nine feet, and two ten feet in diameter. Each silo is twenty-two feet deep. Two by four inch dressed fir lumber was used in the construction of these silos. In the nine foot silos the two by fours were used with square edges. The staves of one of the larger silos were beveled so that they would fit snugly both at the inner and outer surfaces. The remaining silo was constructed with tongued and grooved staves. The two smaller ones and the one constructed with tongued and grooved lumber proved satisfactory, with results in favor of the latter. The one built with beveled staves was very unsatisfactory, as much of the silage in contact with the walls was spoiled, which was manifestly due to the admission of air. This was largely attributable to faulty workmanship in making the bevel.



PLATE I.

THE LOCATION OF THE SILO.

The proper location of the silo for convenience in feeding should be given careful thought. While ensilage is not bulky it is exceedingly heavy, containing, approximately, eighty per cent of water. Hence, if it is to be conveyed any distance by manual labor, it means an unnecessary as well as an expensive expenditure of human energy. The silo may be constructed within the barn or on the outside, but wherever it is placed it should be convenient both for filling and for feeding. When the silo is constructed within the dairy barn, a good plan is to place a partition between the silo and the cows. This, in a measure, prevents the building from becoming permeated with the odor of silage, which has been thought in some instances to be responsible for objectionable flavors of the milk. This difficulty is entirely eliminated when the silo is located outside of the barn. A good arrangement is to have the silo constructed a few feet from the barn. The space between the silo and the barn may be enclosed, with a door leading into the barn. This door can be made sufficiently wide to permit a feed truck being placed immediately beneath a chute arranged for direct delivery of the silage. Thus the labor of feeding silage is greatly lessened. In removing silage from a silo located within the barn, care should be taken that none of it be permitted to remain on the floor after feeding. It is quite likely that this portion of the silage, even if it be a small amount, will give rise to more of the objectionable odor than the silo itself produces.

FORM OF SILO.

The consensus of opinion of those who have studied the silo problem, indicate that the circular form is preferable. There are, however, many square and rectangular silos in successful operation; especially is this the case with those having rounded corners. For the average dairyman and farmer in this state, the stave circular silo will prove entirely satisfactory. Where great strength and large capacity are demanded, the frame circular silo will best meet the requirements. This form of silo can be made quite durable by plastering the inside with cement. The pit silo in some localities can be used to advantage, and its merits are worth the consideration of agriculturists located in semi-arid districts where lumber and other material are usually expensive. These excavations, when practicable, should be made in sloping ground, with a trench dug

for an approach, as well as serving the purpose of an opening for a continuous door. The walls of these pits could perhaps be cemented so as to keep them intact. When constructed after this method such silos should prove to be very durable. The circular stave silo, owing to its simplicity and economical construction, seems to fully meet the requirements of the farmer. With this form of silo properly erected, the waste of silage is reduced to the minimum. There are no corners, or bulging of walls to permit air to enter deeply into the silage.

MATERIAL FOR THE SILO.

Silos may be constructed from stone, brick, or wood; but owing to the abundance of excellent material, so easily procurable, and the entire satisfaction following, thus far, the use of the properly constructed stave silo, we recommend the wooden silo for general use at present. The staves are best made from common fir lumber, free from knots. These can easily be obtained up to twenty-five or even thirty feet in length. These staves can be used either rough or planed. They may be put into the silo with a square edge, so that the edges of the staves on the inner side of the silo will be pressed very tightly together, leaving a slight opening on the outer surface of the silo between each stave; or they can be beveled so that they will fit snugly both on the outer and inner surface of the silo. This, however, must be carefully done to obviate open spaces between the staves. While the planed, tongued and grooved stave increases the first cost of the silo, it is believed to be the cheapest and best in the end. There is practically no danger of collapse with these silos when empty and the walls can be made perfectly air-tight, thus ensuring a more perfect preservation of the silage.

For the construction of silos twelve feet or less in diameter, staves four inches wide would be most desirable; but for silos over twelve feet in diameter, staves six inches wide would be better. The larger silos will require a stave two inches in thickness, while those one and one-half inch thick will suffice for small silos.

FOUNDATION FOR THE SILO.

The foundation for the circular stave silo only, will be considered at this time. These silos are sometimes simply placed on the ground after the surface has been leveled. This, however, is not a satisfactory plan, as rodents not infrequently burrow underneath the walls and up into the silage, often resulting in much spoiled material.

The foundation may consist of lumber, which will probably prove as durable as the bottom portion of the staves of the silo. When lumber is used for the foundation, the ground should first be made level and well hammered down. Then lay two-inch plank, placed as close together as possible, and cover this with one-inch plank so as to break joints. A good foundation can be prepared with small rock or gravel. An excavation is first made from four to six inches deep, slightly larger than the contemplated silo. This is filled with the rock, which is to be well hammered down, and the whole can be covered with a thin layer of well puddled clay. The best, and perhaps the most economical foundation in the end, is that of concrete. Instead of using the clay after the rock or gravel has been firmly packed, the interspaces are filled with a thin mortar, consisting of one part of cement to four or five parts of sand. This should be well worked in so as to fill up all spaces between the rock or gravel and leave a level surface. After this sets, the whole should be surfaced with a thin mortar consisting of one part of cement to two or three parts of sand, over which a little dry cement can be worked in with a trowel, so as to give it a hard finish.

To facilitate the placing of the staves, a circle can be described by first driving a spike in the center of the foundation, before the cement becomes thoroughly set. To this attach a string one-half the length of the diameter of the proposed silo, and to the loose end fasten a file or some pointed instrument with which to strike the circle. A similar circle can also be described on a wooden foundation.

The material required for a concrete foundation of a stave silo twelve feet in diameter will be approximately one yard and two thirds of rock or gravel, four barrels of sand and one of good cement.

For large deep silos, where the weight of silage will be considerable, the excavation for the foundation should be somewhat deeper and the bottom covered with good sized flat surfaced rocks. Whatever class of foundation is adopted, care must be exercised to have it level and free from hydrostatic water.

SIZE OF SILO.

Perhaps more serious losses have resulted through lack of proportion between the size of the silo and the amount of silage fed daily, than from any other cause. The mistake is very generally made in having the exposed surface too large. An excellent rule is to so construct the silo that the horizontal feeding area for each cow will

not exceed five, or the extreme limit of six square feet. When the silo is opened for feeding, a thin layer over the whole surface of the silo should be fed each day, so as to obviate the spoiling of any silage from too long exposure to the air. The approximate average weight of a cubic foot of silage is forty pounds, thus, five cubic feet will contain about two hundred pounds of silage. A cow will consume daily about thirty-five to forty pounds of silage, hence it requires a layer of about two inches thick, extending over five square feet, to supply the requisite amount. When the exposed surface of the silo exceeds five or six square feet per cow fed, the silage is removed too slowly, hence active decomposition ensues, which injuriously influences the quality of the feed.

It is doubtful if a silo less than six feet in diameter will be found practical, as the friction from the walls will be so great in proportion to the weight of the silage, that the contents will not settle properly.

The following table is offered as a guide in determining the proper diameter of a silo for a given number of cows:

Diameter of Silo. Feet.	Number of Cows.	Diameter of Silo. Feet.	Number of Cows.
6.....	5	14.....	25 to 30
7.....	6 to 7	15.....	29 to 35
8.....	8 to 10	16.....	33 to 40
9.....	10 to 12	17.....	37 to 45
10.....	13 to 15	18.....	40 to 50
11.....	15 to 18	19.....	47 to 56
12.....	17 to 22	20.....	52 to 62
13.....	21 to 26		

The depth of the silo is an important factor in its construction. Deep silos are preferable to shallow ones. The pressure from the silage in a deep silo will be greater than that in a shallow one, hence a deep silo will contain a greater weight of silage and less entangled air in proportion to the volume of silage than a shallow one. The diameter remaining the same, a silo 36 feet deep will store nearly five times the amount of feed that one 12 feet deep will. The silo should be at least 20 feet deep, while a depth of 30 feet would be better.

Since the capacity of the cylindrical silo is not as easily computed as that of the square or rectangular form, the following table is given, showing the approximate capacity of a circular silo for ordinary corn or clover silage:



PLATE II.



APPROXIMATE CAPACITY OF CIRCULAR SILO, IN TONS.

Depth of Silo. Feet.	Inside Diameter of Silo in Feet.*													
	10	12	14	15	16	18	20	21	22	23	24	25	26	
20	26	38	51	59	67	85	105	115	127	138	151	163	177	
21	28	40	55	63	72	91	112	123	135	148	161	175	189	
22	30	43	59	67	77	97	120	132	145	158	172	187	202	
23	32	46	62	72	82	103	128	141	154	169	184	199	216	
24	34	49	66	76	87	110	135	149	164	179	195	212	229	
25	36	52	70	81	90	116	143	158	173	190	206	224	242	
26	38	55	74	85	97	123	152	168	184	201	219	237	257	
27	40	58	78	90	103	130	160	177	194	212	231	251	271	
28	42	61	83	95	108	137	169	186	204	223	243	264	285	
29	45	64	88	100	114	144	178	196	215	235	256	278	300	
30	47	68	93	105	119	151	187	206	226	247	269	292	315	
31	49	70	96	110	125	158	195	215	236	258	282	305	330	
32	51	73	101	115	131	166	205	226	248	271	295	320	346	

*Professor Woll's Book on Silage, page 39.

In estimating the quantity of silage required for the feeding of a given number of cows for a certain period, a deduction should be made of about ten per cent from the amount of original fodder put into the silo. This unavoidable loss is due to an apparently uncontrollable fermentation of the silage. Hence a cow fed forty pounds of silage per day, for 180 days, will consume 7,200 pounds of silage, or about four tons of the original fodder. In making calculations as to the length of time a silo will supply feed on the basis of two inches being fed daily, about one-sixth should be deducted from the total height of the silo, as after two or three fillings the silage, when settled, will probably not occupy more than five-sixths of the silo.

A good crop of corn, clover, or vetch will furnish about ten tons of green fodder per acre. Hence one acre at this rate will give nine tons of silage, or sufficient to supply 450 rations for one cow. This estimated yield can be taken as a basis for calculating the area of land required to fill a silo of given capacity. For example, to fill a silo holding 100 tons of silage, the crop of 11 acres of land will be required. Much larger crops than this can be grown on land well cultivated and properly fertilized.

CONSTRUCTION OF SILO.

There are various modes employed in putting up the silo. If the silo is to be constructed within a building, the operation will be comparatively easy. In constructing a silo on the outside of the barn,

as shown in Plate I, after the foundation is properly laid, it is best to erect a scaffold. This can be done by first setting up four 6 x 6 posts at the corners of a square sufficiently large to encompass the silo. To these nail securely 1 x 6 planks, horizontally, one near the bottom, one halfway up, and a third near the top on each side of the square. To these planks, at each angle of the square, nail 1 x 6 pieces so that the inner edge will just touch the staves when set up. Then place in position one stave and tack it to the 1 x 6 at the angle of the square. Care should be exercised to have the first stave perpendicular to the point where it rests upon the circle previously drawn on the foundation. As each stave is placed in position, it should be toenailed at the top. When a few staves have been placed, boards can be nailed across the top. They will serve both as a platform and as a support to the staves. To maintain an uniform circular outline during the time the staves are being put in position, an ordinary templet may be used. Prof. Clinton of Cornell University recommends old barrel staves for this purpose. For the small silo the stave of the sugar barrel is best adapted, and for the larger ones the stave of the cement barrel may be employed. These are tacked on horizontally with shingle nails, near the bottom and half way up on the inner side of the silo. The templet is easily made and will prove equally as satisfactory as the barrel staves. Drive a nail into the floor, to which attach a string one-half the length of the diameter of the proposed silo with a pencil or pointed instrument fastened to the loose end. Then lay a one by six inch plank on the floor in such a position that in describing a circle the plank will occupy the largest possible space. Start the saw upon the mark made and this will furnish a pattern for the rest. A sufficient number of these should be sawn out to reach around the silo. When a few staves are in position, tack a section of the templet horizontally at the bottom. This should be repeated as often as necessary until the silo is completed. After the staves are all in place the hoops should be put on; then remove the templet. When slightly beveled, tongued and grooved staves are used, no templet will be required. Simply place the staves on the circle and toenail at the top. Nothing should be permitted to project on the inner side of the silo, as it would interfere with the proper settling of the silage. The cleats for the doors are to be placed on the outer side, and the silo when completed ought to have a perfectly smooth surface on the interior.

HOOPS FOR THE SILO.

These can be made of any suitable material, such as half-inch, seven-sixteenth inch, or five-eighths inch round iron; one-eighth inch flat iron, two inches wide, or wire. The size of the hoops being governed by the capacity of the silo. For a silo twelve feet or less in diameter, seven-sixteenths inch round iron will be sufficient. The round hoops are more generally used and give good satisfaction. These can be put on in sections and held in position by means of lugs, or may be fastened in studding as shown in Plate II. The woven wire fence hoop is often used, since it is regarded as being very economical. It can be adjusted by wrapping the wire around and fastening it to two 4 x 4 pieces of wood, the latter to be drawn together by five-eighths inch bolts. The bolts to be placed near the ends of the four by fours and furnished with a long cut thread, so as to permit of being tightened. The wire to be cut so as to allow the four by four pieces to come within ten inches or a foot of each other. A couple of flat pieces of iron, curved to fit the outer surface of the silo, such as a piece of an old wagon tire, may be placed underneath the four by fours, so as to preserve the symmetry of the silo.

It is estimated that the pressure from silage when settling, at the time of filling, increases with the depth at the rate of 11 pounds per square foot for each 12 inches of depth. At a depth of 10 feet the lateral pressure is 110 pounds per square foot, at 20 feet it is 220 pounds, and at 30 feet 330 pounds.* Hence it will be seen at a glance that the hoops should be larger and stronger at the bottom of the silo than at the top, or their strength be augmented by placing them closer together. The first hoop may be placed six inches from the bottom, the next a foot above this, and increase the space six inches between each hoop until the distance between them reaches four feet, which should be maintained to the top of the silo. A lighter hoop may be used towards the top, as the pressure from the silage there is comparatively small. In using the wire fencing, sufficient space between bands should be allowed for doors.

DOORS FOR THE SILO.

These may be simply sawed out, as shown in Plate I, or made continuous from the bottom to the top of the silo. The latter form

* King. Physics of Agriculture.

will slightly increase the cost of the silo, but is thought to possess sufficient advantages over the former to more than justify the additional expense. The sawed out doors may be ranged one above the other, with a stationary ladder placed alongside, running to the top of the silo, as shown in Plate I. A convenient size for the door is two feet wide and about two and one-half feet high. The lower door may be cut out between the third and fourth hoops, and the others in every other alternate space save the one at the top. The doors should be planned before setting up the silo, and when the joint is reached where the doors are required, the saw should be started at the top and bottom of each space allotted to a door, and run at an angle of 45 degrees to the inner surface of the stave. Hence the bevel is cut so that the opening will be larger on the inside of the silo. If tongued and grooved material is used, the tongue should be cut off where the edges of the door will come before the stave is fitted to its place. When the staves are all up in position, two cleats of two by three inch material, which have been prepared to fit the outer surface of the silo, should be nailed or bolted firmly to the doors before they are cut out. When plain edged staves are used, the short staves between the doors should be held in place by driving staples over the hoops. In filling the silo these doors are to be placed back just as they were sawed out, with a strip of tarred paper inserted at the top and bottom.

There are many patterns of the continuous door in use. The space for the door is usually about twenty inches wide, and the frame is made by bolting two strong pieces of timber firmly together. The door of the silo represented in Plate II is made by bolting two 4x6 pieces together with five-eighths inch bolts passing through short pieces of gas pipe between the frame to keep it apart. This frame is set up plumb, and braced, the inner side being placed on the edge of the circle. The first stave next to the frame is beveled, so as to make a close fit. When a sufficient number of staves are placed in position to complete about one-third of the silo, another 4x6 is erected, into which a double set of holes have been bored to receive the sections of hoops. The staves coming in contact on either side of this piece are beveled, so as to make a tight joint. On the completion of the second third, a similar 4x6 piece is let in, and when the staves are all in position, there are four of these 4x6 timbers, including the door frame. The edges of the door and frame are beveled to make a snug fit. The doors are made

in sections about two and one-half feet long of the same material as the staves, and, as the silo is filled, they are placed one on top of the other with strips of tar paper around their edges. The door frame bolts are placed thirty inches apart and serve the purpose of a ladder. By using wider timbers for the door frame and placing a piece of canvass next to the bolts, a very convenient chute is formed to convey the silage into a truck or other receptacle. Another good door frame is constructed by bolting two 3x6 pieces together edge-wise, about 20 inches apart with five-eighths inch bolts. If flat hoops are used, before the frame is set in place, grooves are cut to permit the hoops to pass between the frame and first stave. Two holes are to be made in the end of the hoop so that it can be fastened with nails or screws when looped around the door frame. The first stave on each side of the door is nailed or bolted solidly to the frame, about one inch from the inner edge. The doors can be made straight or curved to correspond with the silo, and may be hinged, with the top and bottom beveled so as to fit snugly, or the top and bottom may be left square and the doors placed one upon another as the silo is filled. A simple plan for the construction of a continuous door is to first make it in one piece, care being taken that the cleats are in proper position, then saw it into sections of the desired lengths for doors. These can be numbered so that they will occupy the same position when placed in the silo that they filled in the original piece. The doors can be made to correspond with the silo if the staves are beveled, and by having the cleats sawn with the proper curve. The hoops can be fastened in the rear of the silo with lugs, or square loops can be made at each end of a hoop and two 3x3 pieces of wood passed through the loops and tightened by bolts. When round iron hoops are used, these may pass through the door frame and be held securely by a double tap with a heavy washer. In the rear they can be fastened with lugs. In small silos with sawed out doors, a continuous hoop may suffice, but with large silos, hoops put up in two or more sections are better, as this insures a more uniform tension.

During the summer season, when the silo is usually empty, the hoops will probably need tightening; neglecting to do this may result in a collapsed silo.

PRESERVATION OF THE SILO.

The life of a wooden silo may be prolonged by using some preservative material to protect it from decay. Many different prepa-

rations have been recommended, but coal tar is the one generally used. This can be put on while hot or after dissolving in gasoline. In the latter mixture the proportions are about half a gallon of coal tar to two-thirds of a gallon of gasoline. This must be frequently stirred while it is being put on. Gasoline is highly inflammable; hence care must be exercised to have no fire in the vicinity when the mixture is applied.

Three of the Station silos are treated with preservative; one with hot coal tar; one with raw linseed oil, and a third with carbolineum avenarius. The edges of the staves should be thoroughly treated before putting the silo together, after which the inner surface of the silo may receive a similar coating. This treatment may be followed with an annual or biennial application of the preservative.

ROOF OF THE SILO.

When the silo is built on the outside of the barn a roof is needed. This may be simply a shed roof constructed with plank, or a neat inexpensive shingle roof as shown in plate II. The roof of this silo is supported by a 6x6 frame, set on the top of the silo. It is better to have a comparatively large door at the gable end, rather than a small one, as considerable door space is desirable when the common elevator is used.

FILLING THE SILO.

The method usually employed in filling a silo consists of first passing the forage through a cutter, and then conveying it to the silo by an elevator, or a blower. To a small farmer the necessary outlay for this machinery is a question of vital importance; hence many, on this account, are deterred from adopting the silo. However, there are a large number of silos which have been operated successfully with uncut forage. It is generally conceded that passing the forage through a cutter before putting it into the silo has a decided advantage over the system of putting it in whole. From a close observation recently made as to the relative cost of the two methods, it was found that it required practically the same amount of labor to put whole clover into the silo as it did the cut clover, the only saving being in the engineer and the cost for use of machinery. The cut silage is in a much more convenient form for feeding and can be taken from the surface of the silo in layers of a uniform depth. It was also noted that much more cut than uncut forage could be gotten into the silo. In two silos of equal size it re-

quired 20.41 tons of cut clover to fill one of them on the first run, while only 10.64 tons of whole clover could be gotten into the other at the first attempt to fill. This ratio, however, is not liable to be maintained, as the whole clover will settle much more than that which is cut.

The addition of water to whole material while filling the silo, materially assists in making the silage more compact. This, however, is almost impracticable in the absence of a convenient water system. To elevate by hand the quantity of water required for this purpose, represents considerable labor. When whole material is used it should be handled in as fresh a condition as possible; so that by retaining its weight the settling of the silage is facilitated.

Also, in filling a silo with whole material, care should be exercised to have it kept level and thoroughly tramped. In small silos the material can best be thrown in with a pitchfork. This can be accomplished by putting up a light staging. The use of a derrick or hay fork in filling a small silo is not advisable, without very small loads are taken at a time, as it will be found almost impossible to properly spread a large load of tangled material when dumped into a small silo. With a large silo the use of the hay fork or derrick will be entirely feasible.

There need be no haste in filling a silo. If a few loads are put in each day until it is filled, the silage will be likely to become more compact than if it were filled hurriedly. If it is desirable to perform the work more rapidly, the silo can be filled and allowed to settle for two or three days, then refilled. This operation may have to be repeated three or four times in order to secure the maximum amount of silage in the silo. In case sufficient material is not ready to complete the filling of the silo, other material may be added at any time. It would be well, however, to first remove the covering, or spoiled silage on the surface of the silo.

When cut fodder is put into the silo the carrier should be adjusted so as to deliver the material in the center of the silo, thus facilitating its proper distribution. In filling with corn there is a tendency towards an uneven distribution of the ears; these, being heavier than the other portions of the plant, fall to the outside, resulting in the uneven settling of the silage. To obviate this, many devices are employed, the most simple of which is a long bag open at both ends and fastened to the end of the carrier. A small rope attached to this bag enables it to be manipulated so as to

have the corn deposited in any part of the silo desired. There is no apparent necessity for these devices with other forage crops. The principal item to observe is to keep the contents of the silo level and well tramped. In small silos the tramping should be very thorough, so as to get the greatest possible weight of silage in a given space; for, as before stated, the friction and consequent resistance to the settling of the silage is greater in proportion in a small silo than in a large one.

DANGER IN FILLING SILOS.

During the period of active fermentation of the silage, carbon dioxid is generated quite rapidly; hence to guard against any possible accident, a lantern should be lowered before descending into the silo. If the light continues to burn at the bottom of the empty space it will be safe to enter. This precaution need only be taken when considerable closed space intervenes between the silage and top of silo. Cases are on record where people have been suffocated by going down into silos containing carbon dioxid. In the absence of a light to test for this gas, it would be a good plan to allow some material to be put in before entering the silo, as this will create circulating currents of air and eliminate all danger.

COVERING FOR THE SILAGE.

The original plan in the early period of the silo, was to cover the siloed fodder with boards which were heavily weighted with rock or earth. This custom, however, has been abandoned in recent years, as silage has been found to keep equally as well without the additional weight. The common practice of the present is to allow the material at the exposed surface of the silo to decompose, thus forming an impenetrable coat and excluding the air. This system, however, at times, results in a great waste of silage, as with clover or other spongy substances, decomposition extends downwards for some distance. A common practice is to put water on the surface of the silage at the rate of about one gallon to the square foot, then tramp down thoroughly. This causes a compact decomposed mass to form on the top of the silage which effectually excludes the air, and reduces the amount of spoiled silage to the minimum. Some siloists recommend a heavy sprinkling of grain, to be followed by an application of water every few days. This is supposed to form a very dense growth of roots, which, with a thin layer of decomposed material, affords a good protective coating for silage. When the op-



PLATE III—A Silage-fed Cow.

eration of filling the silo is completed, it is a good plan to cover the silage with at least six inches of cheap material, such as marsh grass or succulent weeds.

CROPS FOR SILAGE.

Corn, from the ease with which it can be converted into silage, is perhaps entitled to stand at the head of all forage plants for this purpose. The solid stems, flat leaf, and proper ratio between its liquid and solid constituents, seem to favor it for this work. The plant, however, is comparatively poor in protein; hence for western Oregon the leguminous crops will give better results to the general farmer.

Of the legumes, clover is probably the most valuable plant, both for hay and silage. Its heavy yield, richness in protein and soil renovating qualities, will command the attention of all progressive agriculturists. Clover, with the possible exception of alfalfa, can probably be grown and placed in the silo at a lower cost than any other forage crop.

Vetch is another valuable legume and grows profusely in the western portion of the state. It will thrive in a greater variety of soils than clover and can be sown as a catch crop either in the spring or fall. It is very palatable to stock and about equal with clover in nutritive principles and adaptability for silage.

Alfalfa is also a good silage crop, and while it is only grown to a limited extent in western Oregon, it is very widely distributed in the eastern and southern portions of the state. This plant, under favorable conditions, will yield a crop representing perhaps a greater value per acre than any other forage crop grown. With the silo to preserve it in its succulency, this crop can be made of inestimable value to the dairying and stock growing industry in the semi-arid portions of the state.

The field pea makes a good silage crop. They can be grown under greatly varying conditions; are rich in protein, but stock do not relish them quite so well as clover and alfalfa.

There are other farm crops which are adapted for silage, but the ones mentioned are more generally grown and fully meet the requirements of the siloist.

Some unsatisfactory results have followed attempts to ensilo peas and vetch when grown with grain. While the grain will materially aid in holding the vetch and peas up, thus facilitating the harvest-

ing of the crop, too large a proportion of grain is undesirable when the crop is to be ensiled. The hollow stems of the grain carry more or less air into the silo, which is thought to accelerate fermentation and consequent deterioration of the silage. The best forage plants for silage are generally those with solid stems and which carry over twenty per cent of solid matter in their physical structure. Very succulent plants, such as cabbage, rape, and immature corn, clover, alfalfa, or vetch, when carrying much less than twenty per cent of solid matter, are unsuited for silage.

In recent experiments conducted at this Station with siloed immature clover, containing 79.14 per cent of moisture, it was found that a great quantity of its liquid constituents oozed out at the bottom of the silo. An analysis of this exudate showed that it contained 1.13 per cent protein. This is not large, but nevertheless represents a loss of valuable nutrients.

THE TIME FOR HARVESTING SILAGE CROPS.

Recorded results of a large number of experiments with silage warrants the conclusion that plants are in the best condition for silage when they are fairly well matured. Corn is seemingly in the best condition for the silo when the kernels are nicely glazed, just after the roasting-ear stage. In some seasons, corn suffers injury from autumn frosts. As a result of this injury, it becomes shriveled and dry, and the farmer usually concludes that it is not available for the silo. Frosted corn will make fair silage if the precaution is taken when putting it into the silo to add sufficient water to bring the moisture content up to what it would be under normal conditions.

Clover is in the best condition for the silo when it reaches the proper stage for hay; that is, when it is slightly beyond full bloom, and the first heads begin to discolor. It should be put into the silo as soon as possible after cutting. To permit it to wilt very much, will seriously interfere with its packing in the silo, unless water is added. It is quite probable that the reported failures with clover silage are largely due to the material not becoming sufficiently compact in the silo to exclude the air. This, in a measure, may be due to unnecessary wilting of the fodder before putting it into the silo.

Alfalfa is harvested for silage when in full bloom. Although failures have been reported with alfalfa as silage, there are, however, a great number of dairymen who have been eminently successful in siloing this crop.

Vetch is in the best condition for the silo when the first seed pods are nicely formed. In full bloom it is exceedingly succulent, carrying approximately eighty per cent of moisture. All classes of farm stock relish this forage plant; it is rich in flesh-forming substances, and useful for hay, soiling, or the silo.

Peas are ready for the silo when over fifty per cent of the pods are slightly advanced beyond the "green pea" stage. This crop seems to be especially well adapted for silage. Several tons were put into one of the Station silos last season, at the stage of ripeness mentioned, and came out in excellent condition. The silage possessed an agreeable aroma and the original color of the forage was well preserved.

With the various other forage crops suitable for silage, such as sorghum, grass, soja beans, millet, &c., a fair degree of ripeness before they are committed to the silo is indispensable to success.

METHODS FOR HANDLING SILAGE CROPS.

When large crops of corn are to be harvested for the silo, the modern corn binder is the thing. For the small crop, the corn knife will be a more appropriate implement. The corn knife, wielded by an active man, can be made to cut a surprisingly large amount of corn in a day. In using the knife the corn should be deposited in bunches of such a size that they may be taken up conveniently at one armful and loaded on the wagon. The work of loading will be facilitated by having the bunches of corn placed across the row so that they can be picked up easily. It has been suggested that low wagons be used for hauling the corn, with a portable platform attached at the rear, so that the loader can walk up into the wagon and deposit his armful of fodder. When the loading is completed, the platform is transferred to the next empty wagon. A very simple and effectual device for cutting corn consists of a sled with a cutting knife attached to the side near the front, at an angle of about forty-five degrees. The sled is hauled by one horse beside the corn row, and a man, kneeling on the platform, gathers the corn in his arms as it is cut off and deposits it in bunches on the ground. An ingenious device, operated on a somewhat similar plan when attached to a wagon, permits the corn to be loaded as it is cut. The platform is removable and may be attached to other wagons on the completion of the loading.

In harvesting the finer growing forage crops, the mower and rake answer all purposes. The plan followed by the Station, is to mow in strips and follow closely with the rake. We do not aim to cut more than one load at a time, and when the load is cut, the men operating the mower and rake assist in loading, making three loaders in the field a large portion of the time. Where the distance from field to silo is comparatively short, we find that two teams with three wagons will deliver as fast as the cutter will handle it. On cloudy, or showery days, it will do no harm to have several loads cut ahead; but in hot, clear weather, it is best to have the forage gathered up closely after the mower. If by accident the forage becomes much wilted, water should be added, either in the silo, or as it ascends the carrier. This item of moisture is an important one with clover and vetch silage. When these plants are in the best condition for silage, their moisture content is perhaps as low as may be safely risked in the silo. Forage carrying too large a percentage of solid matter in proportion to its moisture does not become sufficiently compact to effectually exclude the air. To allow clover, at the proper stage of ripeness, to go into the silo in a wilted condition, without adding water, invites failure. It is doubtful if adding water to unwilted fresh clover cut at the proper stage, will improve the silage. Hence the indiscriminate use of water, regardless of the condition of the clover, may not be good practice.

ACIDITY OF SILAGE.

The problem of sweet and sour silage continuously comes up and much theorizing has been indulged in. It is not our purpose to advance any new theory on this perplexing question. That some silage is exceedingly sour is a well known fact; but the cause or causes of this condition are not well known. The work of the Station on silage during the year just passed was more along practical lines than those of scientific research. However, the data obtained as the results of the work will be an aid in our efforts towards further investigations. The major portion of the work was with clover, and the object sought was to determine the effects of adding water to clover silage, both as to its influence on the acidity and protein content. The results obtained from these experiments seem to indicate that there are at least two conditions which favor the development of organic acids in silage, i. e. immaturity of the plant, and

extreme compactness of the silage. A good example of the former is shown in the analysis of the immature corn silage.

It will be proper to mention that the chemical work of these investigations was done by Mr. F. E. Edwards, Assistant in Chemistry, who also supplied the tables.

IMMATURE CORN SILAGE.

	Original Sub- stance.		Water-free Sub- stance.	
	Green Fodder	Silage.	Green Fodder	Silage.
Moisture	75.18	80.09		
Dry Matter	24.82	19.91	100.00	100.00
Ash	1.40	1.23	5.63	6.19
Protein	2.03	2.07	8.18	10.89
Crude Fiber	5.23	4.25	21.07	21.37
Fat	.68	.75	2.53	3.75
Nitrogen-free Extract	15.53	11.61	62.59	58.30
Acidity as Acetic Acid		1.94		

The "silage" analysis above is from a composite sample made up of three partial samples taken at different depths in the silo. The "green fodder" was taken as the corn went into the silo.

1901.	Moisture.	Solids.	In 100 grams silage	Acidity.		Water-Free		Orig. Subs.
				As Acetic Acid.	Protein.	Nitrogen.	Protein.	
April 30	77.91	22.09	370 c. c. N ₁₀₀ NaOH.	2.22	9.86	1.58	2.18	
May 11	81.20	18.80	320 " "	1.92	10.26	1.64	1.93	
15	81.16	18.84	280 " "	1.68	9.65	1.54	1.82	
Average	80.09	19.91	323 c. c. N ₁₀₀ NaOH.	1.94	9.92	1.59	1.98	

The corn for this silage was harvested when the kernels had reached what is known as the dough stage. The moisture content as represented by the green fodder is below what it should be. This is due to the fact that the composite samples of the fodder were collected in an open vessel which permitted of more or less transpiration, before moisture determinations were made. The amount of moisture found in the silage would perhaps more nearly represent that of the green fodder.

This corn silage, although very acid, as determined by the analysis, was exceptionally well preserved so far as general appearance and color were concerned. It possessed an agreeable acid odor, and, notwithstanding the 2.22 per cent of acid which some of it contained, the cows ate it with avidity. There were no appreciable harmful results from feeding this exceedingly sour silage. The period of feeding, however, was brief, only extending over two weeks.

With the clover the results were slightly different as the following tables will indicate:

ANALYSES OF PARTIAL SAMPLES, SILO No. 1.

1900.	Moisture.	Solids.	Acidity.	
			In 100 grams Silage.	As Acetic Acid.
Aug. 2	78.24	21.76		
13	66.39	33.61		
20	72.94	27.06	117.5 c. c. N ₁₀ NaOH	.71
25	74.80	25.20	102	.61
29	71.05	28.95	112	.67
Sept. 5	77.61	22.39	160	.96
12	77.64	22.36	160	.96
20	77.17	22.83	140	.84
26	74.83	25.17	110	.66
Oct. 6	76.14	23.86	130	.78
13	76.98	23.02	160	.96
19	77.06	22.95	150	.90
27	66.88	33.12	120	.72
Nov. 3	76.09	23.91	150	.90
10	76.72	23.28	140	.84
Average	74.70	25.30	134.7 c. c. N ₁₀ NaOH	.81

ANALYSES OF PARTIAL SAMPLES, SILO No. 2.

1900-1901.	Moisture.	Solids.	Acidity.		Water-Free Substance.		Orig. Subs.
			In 100 grams Silage.	As Acetic Acid.	Nitrogen	Protein	Protein
Nov. 19	82.17	17.81	180 c. c. N ₁₀ NaOH	1.08			
27	82.36	17.64	230	1.38			
Dec. 4	79.43	20.57	150	.90			
11	76.97	23.03	180	1.08			
18	78.94	21.06	180	1.08			
24	74.60	25.40	160	.96			
Jan. 3	73.25	26.75	220	1.32	1.99	12.44	3.33
9	74.25	25.75	260	1.56	2.26	14.12	3.64
16	75.36	24.64	200	1.20	2.06	12.88	3.17
25	75.78	24.22	200	1.20	2.17	13.56	3.28
Feb. 4	76.02	23.98	160	.96	1.87	11.69	2.80
Average	77.20	22.80	192.7 c. c. N ₁₀ NaOH	1.16	2.07	12.69	3.24

ANALYSES OF PARTIAL SAMPLES SILO No. 3.

1901.	Moisture.	Solids.	Acidity.		Water-Free Substance.		Orig. Subs.
			In 100 grams Silage.	As Acetic Acid.	Nitrogen	Protein	Protein
Feb. 9	81.68	18.82	160 c. c. N ₁₀ NaOH.....	.96	1.85	11.56	2.13
20	81.00	19.00	232 " "	1.39	1.73	10.81	2.15
26	82.25	17.75	140 " "	.84	1.89	11.81	2.10
Mar. 8	80.19	19.81	170 " "	1.02	2.04	12.75	2.53
15	75.65	24.35	180 " "	1.08	1.75	10.94	2.66
21	75.65	24.35	184 " "	1.10	1.70	10.61	2.58
April 1	76.39	23.61	180 " "	1.08	1.88	11.77	2.78
8	67.18	32.82	180 " "	1.08	1.85	11.27	3.70
22	75.78	24.22	160 " "	.96	2.11	13.20	3.20
Average.....	77.31	22.69	176 c. c. N ₁₀ NaOH.....	1.06	1.87	11.64	2.65

Complete analyses were not made of the samples at first; determinations only were made as to the solids and acidity.

The analyses were made with composite samples of the daily ration of the herd, taken from the silo on the dates given.

The following table will indicate the date of filling and the amount of clover placed in each silo:

Dates when fodder was placed in the silos.		Approximate weight of fodder, tons.		
1900.		Silo No. 1.	Silo No. 2.	Silo No. 3.
June 8		10.12		
9		6.75	4.50	
11		3.37	10.12	
12			3.37	
14		2.25	2.25	
15				14.62
19			1.12	9.00
22			4.50	7.87
Total.....		22.49	25.86	31.49

The clover cut from June 8th to June 11th, inclusive, was just in full bloom, or slightly too immature for hay. That which was put in Silo No. 3 had reached the proper stage of ripeness for hay. With the exception of about one gallon of water to the square foot of exposed area, put on to give a compact surface, the material in Silo No. 1 was put in as it came from the field, after passing through the cutter. The fodder in Silos Nos. 2 and 3 was watered at the rate of one gallon of water to every hundred pounds of material. These amounts are approximately correct only. Several loads of the forage were weighed and the average accepted as a basis of cal-

culatation for unweighed loads. The water was applied by means of a hose attached to an hydrant. Several determinations were first made as to the volume of flow for a given period, and the average of flow was taken as a basis of calculation for the period required to saturate a given weight of fodder. There is, however, some chance of error, as service elsewhere in the supply pipe at times would result in lowering the pressure and thus diminish the volume of flow.

Silos 1 and 2 are of the same capacity, but the silage in Silo No. 2 had settled much more than that of No. 1. The silos were all filled level full, at least three times. The effect of water upon the settling of silage is shown in the weight of silage per cubic foot. A number of determinations made at different depths in the silos gave the average weight of a cubic foot of silage in No. 1 as 33.65 lbs.; No. 2, 53.33 lbs.; No. 3, 54.63 lbs. Considerable rain fell during a part of the time when Silo No. 3 was being filled. As a result the forage was supersaturated, thus causing heavy seepage at the bottom. It was thought that the addition of such a large quantity of water to the green clover would have a tendency to wash out some of the protein compounds. This, however, did not seem to take place to any appreciable extent.

The following table represents the analyses made from composite samples of all the partial samples taken from each silo:

	Original Substance						Water-Free Substance.					
	Silo No. 1.		Silo No. 2.		Silo No. 3.		Silo No. 1.		Silo No. 2.		Silo No. 3.	
	Green Clover	Silage	Green Clover	Silage	Green Clover	Silage	Green Clover	Silage	Green Clover	Silage	Green Clover	Silage
Water.....	69.89	74.70	63.25	77.20	66.04	77.31						
Dry Matter.....	30.11	25.30	36.75	22.80	33.96	22.69	100.00	100.00	100.00	100.00	100.00	100.00
Ash.....	2.23	2.18	2.67	1.99	2.42	1.89	7.39	8.62	7.23	8.73	7.13	8.35
Protein.....	4.10	3.27	4.54	2.96	3.97	2.69	13.62	12.93	12.36	13.00	11.69	11.84
Crude Fiber.....	9.48	8.41	11.22	7.97	10.70	7.91	31.48	33.18	30.53	34.92	31.49	34.84
Fat.....	.89	.84	1.08	.90	.98	.83	2.97	3.33	2.94	3.93	2.90	3.67
Nitrogen-Free Extract.....	13.41	10.60	17.24	8.98	15.89	9.37	44.54	41.94	46.94	39.42	46.79	41.30
Acid'y as acet. acid	.26	.81	.26	1.16	.26	1.06						

The same possible error occurs in the moisture content of the green clover as was noted in the corn.

It will be seen that the unwatered silage in Silo No. 1 retained a greater percentage of its original dry matter and developed perceptibly less acid than did the watered silage. If this loss of dry mat-



PLATE IV—Some Silke-fed Sheep. Average Weight, 255.83 Pounds.

ter is due to fermentation, this is significant, from the fact that it tends to show that greater fermentation takes place in silage saturated with water than with that carrying a moderate amount. The acidity is apparently the product of fermentation, and the loss in dry matter would indicate that more or less excessive fermentation had previously taken place. There is also a larger percentage of dry matter retained in the silage from Silo No. 3 than there is in that taken from No. 2; and, furthermore, the acidity is slightly less.

These experiments tend to show that acidity and loss of dry matter go hand in hand. This loss occurs in the carbohydrates and allied substances, the protein remaining practically constant. The rather unusual compaction of the silage in Silos 2 and 3 precludes an assumption that fermentation was due to large amounts of entangled air in the silage; for, if this were true, the fermentation would certainly be greater in the less compact silage of Silo No. 1. However, acidity and loss of dry matter may not both be due to fermentation. The acidity may represent the physiological products of the cell life of the plant; or may be due to a slower process of fermentation at a lower temperature. There is evidently a desirable mean between the ratio of dry substance and moisture, which gives the best results in the silo. If the fodder is too dry within certain limits, active oxidation will take place, thus destroying a large proportion of nutritive substances. If, on the other hand, it is too heavily watered, acidity and loss of solid matter are the results.

The Station's work in silage the past year demonstrates thus far that clover, cut at the proper stage of ripeness and put into a properly constructed silo, will make good silage. There is no apparent need for the addition of water to green cut clover when passed through a cutter before entering the silo. Since within proper limits it does no especial harm, it may be used with profit when the clover is overripe, or unduly wilted.

*Cost of Material for a Silo twelve feet in diameter, 24 feet deep.
Capacity, 49 tons.*

1½ yards of rock or gravel	\$ 1.00
4 barrels of sand	.50
1 barrel of cement	4.75
2,260 ft. 2 x 4 tongued and grooved staves at \$20.00 per M	45.20
72 ft. 3 x 6, 24 ft. door frames	1.44
358 ft. ¾ round iron for hoops and bolts; weight, 465 lbs., at \$3.20 per cwt.	14.88
9 lugs at 30 cents each	2.70
54 nuts at 8½ cents per lb.	.60
Preservative	1.50
Total	\$72.57

These estimates are merely approximations and will be subject to variations in different localities. If the silo is constructed outside, the cost of roof and painting must be added.

Plate III taken May 1st, represents a dry Shorthorn cow which from January 1st to May 1st, was fed daily without grain 40 pounds of clover silage and what mixed clover hay she would eat up clean. This cow not only retained her excellent condition on the above ration, but made a satisfactory gain in live weight.

Plate IV represents six Cotswold ewes which were taken off of rape and clover pasture December 1, 1900, and put on clover silage, mixed hay and a light ration of grain. This was fed until March 15, 1901, when they were photographed for the plate.

These illustrations are introduced simply to show that silage has an important field of usefulness on the general farm.

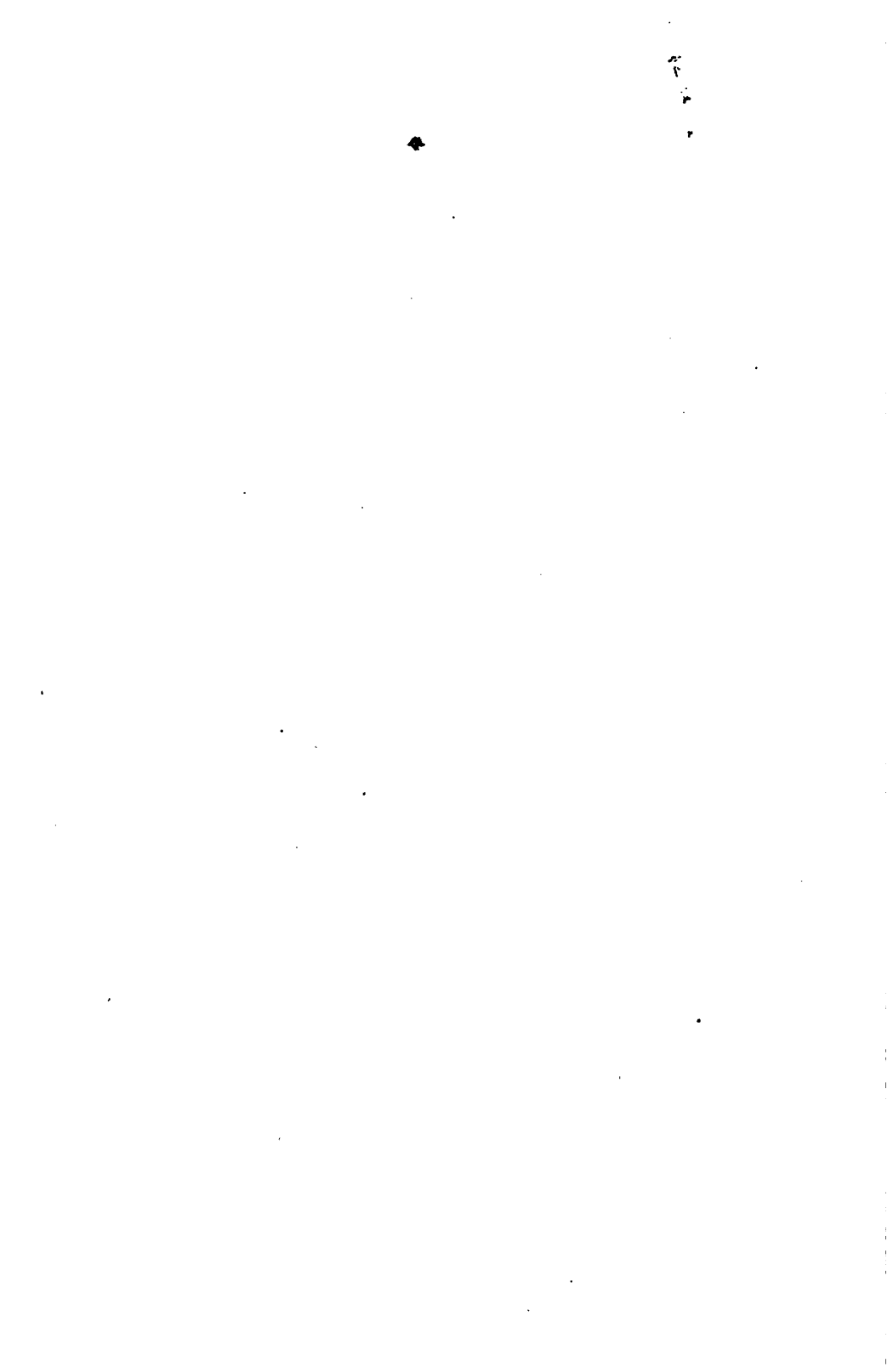
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Bulletin No. 68.

January, 1902.

OREGON AGRICULTURAL EXPERIMENT STATION,

CORVALLIS, OREGON.

ANNOTATED LIST

OF THE

BIRDS OF OREGON

A. R. WOODCOCK.

The Bulletins of this Station are sent Free to all Residents of Oregon who request them.

Oregon Agricultural College Printing Office.
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THE DENNY PHEASANT.

Introduced from China by Judge O. N. Denny in 1880-81. See page 24.

INTRODUCTION.

This Annotated List of the Birds of Oregon is a thesis which was presented to the faculty of the Oregon Agricultural College, for the degree of Master of Science, by Mr. A. R. Woodcock. As an undergraduate student in zoology, Mr. Woodcock was especially interested in the study of our local bird fauna, and presented for his graduating thesis a "List of the Birds of Corvallis and Vicinity," which was so promising that I suggested that he take as the major subject for his Master's degree the work of preparing a list of the birds of the entire state.

In view of the interest in the study of our native birds which has recently been aroused, and wishing to stimulate that interest as much as possible, and particularly in view of the close economic relations which birds bear to the agriculture and horticulture of the state, I feel justified in recommending that the "list" be published as Bulletin No. 68 of the Oregon Experiment Station. It is believed that bird lovers in any part of the state by a perusal of its pages will be able to determine what birds are likely to be found in their particular locality, when the various species are likely to be present, their comparative abundance, whether they are resident or are only seen during migrations, and something of their nesting habits and food relations. It is believed that teachers will find it of value in their nature-study work and that farmers and fruit growers by consulting its pages may learn something of their feathered friends and foes—especially the former.

No one realizes better than does Mr. Woodcock, that in all probability the work contains errors and omissions. Undoubtedly the names of some birds that should properly be credited to the state have been omitted. Only in a few instances has he been able to verify the lists and notes of other observers by comparison with their specimens; hence he should be held responsible only for the species he has personally observed or verified, and each of the other collectors and observers should be credited with their records and be held responsible for them. In every instance the authority for recording a species from a locality is given. The number of observers, particularly in eastern Oregon, is far too small for us to expect

that all birds that occur in the state have been observed and recorded. It is hoped, however, that the publication of the list will greatly increase the number of such observers who will keep accurate notes of what they see, and who will not hesitate to place themselves in communication with the Agricultural College, to the end that future lists may be made more complete. It is also hoped that all who notice errors or omissions in the list will kindly notify us of them.

Oregon is a large state, extending as it does nearly three hundred miles from north to south and four hundred from east to west. Its range of elevation extends from sea level to the perpetually snow covered peaks of the Cascades nearly twelve thousand feet above. Its average annual rainfall varies from about eleven inches in parts of eastern Oregon to ninety-two inches in the northwestern part. It includes within its borders life-zones ranging from the Arctic-Alpine through the Hudsonian, the Canadian, the Transition and the Upper Austral. Representatives of the bird fauna of each of these zones occur within our borders, hence it is reasonable to expect that when fully known the bird fauna of the state will be found to be unusually rich. Mr. Woodcock lists about 325 species as occurring within our borders. In comparison, it may be stated that Cooke lists 387 species from Colorado, Brunner lists 415 species from Nebraska, and Cook 332 species from Michigan. It would seem, therefore, that a considerable number of species that occur within our borders are still unrecorded.

The arrangement adopted has been that of the American Ornithological Union Check List, and the number preceding the name of each species is the check list number.

In an appendix at the end of the list is published the "Bird Laws" of Oregon, and in the index those species which are known to be especially injurious from the standpoint of the farmer and fruit grower are printed in heavy faced type.

A. B. CORDLEY.

ACKNOWLEDGEMENTS.

Having been interested in the study of ornithology for a number of years, at the suggestion of Professor Cordley, I chose as a subject for my thesis in working for the degree of Master of Science, "An Annotated List of the Birds of Oregon." The object has been to make as complete a list as possible from the information at hand, of the avian species which have been taken and observed throughout the state, with the localities from which each species has been reported, the names of observers, and their notes. The notes aim to cover briefly the relative abundance, time of migration and nesting, and food habits, although in the latter line, apparently but little work has been done in the state.

Beside the data secured from original lists of various observers, I have made numerous extracts from the "Land Birds of the Pacific District," by Lyman Belding and the "Life Histories of North American Birds" by Captain Bendire. In the case of notes taken from these publications, the initial letters of the words in the respective titles are appended in parenthesis. Without the aid of these two works the information relative to the birds of the eastern portion of the state would have been very meagre, as thus far, I have been able to locate only one observer there. My chief reliance, however, has been on the original lists and data, contributed by those whose names follow, and I take this opportunity of expressing my sincere thanks for their hearty co-operation and deep interest. I am indebted to Messrs. Ellis F. Hadley, Bernard J. Bretherton, Fred H. Andrews, Robert W. Haines, and Dr. A. G. Prill, for lists from the localities which appear opposite their names in the text; to Mr. A. W. Anthony for a general list; to Messrs. William Warner, Herman T. Bohlman, and Ross Nicholas for the use of their notes, and the data to their collections. I am also under obligation to Mr. Bohlman for furnishing me with a list of the Birds of Sheridan by Mr. Arthur L. Pope, as well as the addresses of several observers with whom I was not acquainted, to Professors Cordley and Shaw for reading the proof sheets, and to Professor Lake for determining certain seeds. I must, too, express my deep gratitude to Professor Cordley for his kindly assistance, advice, and counsel, during the time that he has been my instructor in zoölogy.

A. R. WOODCOCK.

An Annotated List of the Birds of Oregon.

Compiled from Data Furnished by Ornithologists Throughout the State, Together with Extracts from Belding's "Land Birds of the Pacific District," and Bendire's "Life Histories of North American Birds."

BY A. R. WOODCOCK.

Order Pygopodes. Diving Birds. (Piscivorous).

Suborder Podicipedes. Grebes.

Family Podicipidæ. Grebes.

Genus *Aechmophorus*.

1. *Aechmophorus occidentalis*. WESTERN GREBE.

Yaquina Bay. Bernard J. Bretherton. "Common resident, all the year.

Mr. Wm. Warner of Salem, Or., reports a set of four eggs of this species taken at Nye Creek (which flows into the ocean about a mile from Yaquina Bay) on May 26, 1888.

Scio, Linn Co. Dr. A. G. Prill. "Constant resident."

Corvallis. A. R. W. Uncommon; my collection at present contains but two specimens killed on the Willamette river a short distance above Corvallis, one on Nov. 7, 1898, the other on Oct. 24, 1899.

Genus *Colymbus*.

Subgenus *Dytes*.

4. *Colymbus nigricollis californicus*. AMERICAN EARED GREBE.

Dayton. Ellis F. Hadley. "Common resident; found on lakes and ponds."

Genus *Podilymbus*.6. *Podilymbus podiceps*. PIED-BILLED GREBE.

Yaquina Bay. Bernard J. Bretherton. "Tolerably common in the spring and fall."

Dayton. Ellis F. Hadley. "Common resident of Yamhill Co.; nearly every little pond or lake has three or four of these Grebes about it, both winter and summer."

Scio, Linn Co. Dr. A. G. Prill. "Constant resident."

Corvallis. A. R. W. "Resident; not uncommon on sloughs, lakes, and ponds of this vicinity."

Suborder Cepphi. Loons and Auks.

Family Urinatoridæ. Loons.

Genus *Urinator*.

7. *Urinator imber*. LOON.

Yaquina Bay. B. J. Bretherton. "Loons were very plentiful during the fall and winter months until a few years ago, when the crab-fishermen commenced killing them for bait, since which time they have decreased so rapidly as to be now considered rare. A number are also annually caught in the salmon nets."

Elkton. Fred H. Andrus. "Occasionally seen; am not certain as to species."

Portland. R. Nicholas.

A. W. Anthony. "More or less common on all of the waters of the state, chiefly as a migrant."

10. *Urinator pacificus*. PACIFIC LOON. A. W. Anthony.11. *Urinator lumme*. RED-THROATED LOON. A. W. Anthony. "Common on the coast during migrations and in winter. They both seem to be inclined to keep more to salt water than the larger *imber*, and I think are seldom seen on the fresh-water lakes."

Family Alcidae. Auks, Murres, and Puffins.

Subfamily Fraterculinæ. Puffins.

Genus *Lunda*.

12. *Lunda cirrhata*. TUFTED PUFFIN.

Yaquina Bay. Bernard J. Bretherton. "A common but not plentiful summer resident from February to August; breeds in suitable localities along the coast."

Tillamook Co. Ellis F. Hadley. "Found breeding quite commonly along the coast of Tillamook county in June, where I collected quite a number of sets, one egg each, from burrows two to four feet deep in guano, on a small rocky island. No material was used as a nest lining; eggs vary from white to a yellowish buff, with a few lilac markings around the larger ends."

Corvallis. A. R. W. Three individuals of this species were seen, and one secured on the Willamette above Corvallis by Mr. Ross Nicholas of Portland, Or., in April, 1898.

A. W. Anthony. "Common at sea, all along the coast."

Subfamily Phalerinæ. Auklets, Murrelets, Guillemots.

Genus *Cerorhinca*

15. *Cerorhinca monocerata*. RHINOCEROS AUKLET.

Yaquina Bay. Bernard J. Bretherton. "A number of them came ashore during a gale last month (March)." (Per letter April 30, 1901.)

Genus *Synthliboramphus*.

21. *Synthliboramphus antiquus*. ANCIENT MURRELET.

Yaquina Bay. Bernard J. Bretherton. "Occasionally met with in the early spring."

Tillamook Co. Ellis F. Hadley. "A few were noted around the rocky island on the coast of Tillamook county in June and July."

A. W. Anthony. "Found only as a winter visitor along the coast."

22. *Synthliboramphus wumizusume*. TEMMINCK'S AUK.

Yaquina Bay. Bernard J. Bretherton. "A pair taken October 18, 1899, and now in the collection of Mr. Chas. E. Ladd of Portland, Or."

Genus *Brachyramphus*.

23. *Brachyramphus marmoratus*. MARBLED MURRELET.

Yaquina Bay. Bernard J. Bretherton. "Common in May, June, and September."

A. W. Anthony. "Found only during migrations and in winter."

Genus *Cephus*.

29. *Cephus columba*. PIGEON GUILLEMOT.

Yaquina Bay. Bernard J. Bretherton. "Very common summer resident, breeding on every rocky headland along the coast."

Data from the collection of Wm. Warner of Salem, Or., show that he found it breeding on the coast near Yaquina Bay on May 26, 1888.

Subfamily Alcinae. Auks and Murres.

Genus *Uria*.

30. *Uria troile californica*. CALIFORNIA MURRE.

Yaquina Bay. Bernard J. Bretherton. "Tolerably common in summer and winter, breeding on Cape Foulweather."

Order Longipennes. Long-winged Swimmers.

Family Stercorariidæ. Skuas and Jaegers. (Piscivorous.)

Genus Stercorarius.

37. *Stercorarius parasiticus*. PARASITIC JAEGER. A. W. Anthony.

38. *Stercorarius longicaudus*. LONG-TAILED JAEGER. A. W. Anthony.
"I have seen both species off the Oregon coast in winter."

Family Laridæ. Gulls and Terns.

Subfamily Larinæ. Gulls. (Piscivorous.)

Genus Rissa.

40a. *Rissa tridactyla pollicaris*. PACIFIC KITTIWAKE.

Yaquina Bay. Bernard J. Bretherton. "Occasionally met with in the early spring, but not at all common, usually; some years occurring in large numbers."

Scio. Dr. A. G. Prill. "One lone specimen secured at Sweet Home, Linn county, 1891. Identified by Capt. Bendire."

A. W. Anthony. "Found at sea and along the coast during the winter and migrations."

Genus Larus.

44. *Larus glaucescens*. GLAUCCOUS-WINGED GULL.

Yaquina Bay. Bernard J. Bretherton. "Common winter resident."

Tillamook Co. Ellis F. Hadley. "Very common resident; nesting on the rocky islands along the coast."

Portland. A. W. Anthony. "Common on the coast and as far up the river as Portland, where it is seen about the water front all winter."

49. *Larus occidentalis*. WESTERN GULL.

Yaquina Bay. Bernard J. Bretherton. "The commonest gull of the coast, breeding on all outlying islands."

Tillamook Co. Ellis F. Hadley. "Very common resident; nesting on the rocky islands along the coast."

A. W. Anthony. "Found on the coast where it no doubt breeds in all suitable places. I have not seen this species up the river and do not know to what extent it may be found as a winter resident of the state."

Corvallis. A. R. W. Sometimes seen along the river in late summer and early autumn; uncommon.

51a. *Larus argentatus smithsonianus*. AMERICAN HERRING GULL.

A. W. Anthony. "Occurs with *glaucescens*, and equally abundant."

53. *Larus californicus*. CALIFORNIA GULL.

Yaquina Bay. Bernard J. Bretherton. "Tolerably common in summer and possibly breeds here."

A. W. Anthony. "Occurs with *glaucescens* and equally abundant."

54. *Larus delawarensis*. RING-BILLED GULL.
A. W. Anthony. "Occurs all over the state, at least as a migrant."
55. *Larus brachyrhynchus*. SHORT-BILLED GULL.
Yaquina Bay. Bernard J. Bretherton. "Of rare occurrence."
Scio. Dr. A. G. Prill. "Fifteen (15) seen near Scio, Sept. 21, 1900; three (3) were secured. Occasional visitor."
57. *Larus heermanni*. HEERMANN'S GULL.
Yaquina Bay. Bernard J. Bretherton. "Very abundant in summer; out-numbering any other species in August and September; undoubtedly breeds here, although I have not so far identified their nests."
60. *Larus philadelphia*. BONAPARTE'S GULL.
Yaquina Bay. Bernard J. Bretherton. "Rare straggler, only two specimens taken in six years."
Subfamily Sterninæ. Terns. (Piscivorous and Insectivorous).
Genus Gelochelidon.
63. *Gelochelidon nilotica*. GULL-BILLED TERN.
Yaquina Bay. Bernard J. Bretherton. "A very common fall migrant."
Genus Sterna.
Subgenus Sterna.
71. *Sterna paradisaea*. ARCTIC TERN.
A. W. Anthony. "Common on the coast at least as a migrant."
- Order Tubinares. Tube-nosed Swimmers.
Family Diomedeidæ. Albatrosses.
Genus Diomedea.
81. *Diomedea nigripes*. BLACK-FOOTED ALBATROSS.
82. *Diomedea albatrus*. SHORT-TAILED ALBATROSS.
A. W. Anthony. "Both are common off our coast, though the white plumage of the adult Short-tailed is seldom seen. The young in dark plumage are similar to the Black-footed species, but can always be told at a glance by the flesh-colored bill and feet, which are black in the Black-footed."
Family Procellariidæ, Fulmars and Shearwaters.
Subfamily Procellariinæ. Fulmars.
Genus Fulmarus.
Subgenus Fulmarus.

86b. Fulmarus glacialis glupischa. PACIFIC FULMAR.

Yaquina Bay. Bernard J. Bretherton. "Numerous off the coast in September."

A. W. Anthony. "Both (*F.g.glupischa* and *F.g.rodgersii*) are found at sea until late in the spring migrations."

86c. Fulmarus glacialis rodgersii. RODGERS'S FULMAR.

A. W. Anthony.

Genus Puffinus.

94. Puffinus stricklandi. SOOTY SHEARWATER.

Yaquina Bay. Bernard J. Bretherton. "Common off the coast all the year."

Genus Oceanodroma.

106. Oceanodroma leucorhoa. LEACH'S PETREL.

Yaquina Bay. Bernard J. Bretherton. "Common resident—breeds on Cape Perpetua, Yaquina Head, and Cape Foul-weather."

Tillamook Co. Ellis F. Hadley. "Quite common, nesting in June and July, in burrows from one to three feet in length, in guano on small islands along the coast. I have found as many as two pairs of these birds nesting in side tunnels to a nest burrow of a Tufted Puffin, all of these using the same common entrance and hallway with the Puffins, and all seeming to be in harmony. To get this Petrel to leave the nest, a person must remove it by force, when it will almost always eject an offensive reddish oily fluid. One white egg, with the large end marked with reddish brown dots, is laid on the bare dirt in the burrow."

108. Oceanodroma homochroa. ASHY PETREL.

Yaquina Bay. Bernard J. Bretherton. "Although I have been informed that this bird used to be common here, I must classify it as rare, as I have obtained only one specimen in six years."

Order Steganopodes. Totipalmate Swimmers. (Piscivorous or principally so, in their food habits.)

Family Phalacrocoracidae. Cormorants.

Genus Phalacrocorax.

Subgenus Phalacrocorax.

120. Phalacrocorax dilophus. DOUBLE-CRESTED CORMORANT.

Yaquina Bay. Bernard J. Bretherton. "Common winter resident; said to breed here, but not to my knowledge."

120b. *Phalacrocorax dilophus cinctatus*. WHITE-CRESTED CORMORANT.

Tillamook Co. Ellis F. Hadley. "Quite common."

Portland. A. W. Anthony. "On the river at Portland we have a species as a resident that I take in life to be the White-crested."

Portland. Herman T. Bohlman. A specimen taken at Ross Island, in the Willamette, three miles above Portland, Jan. 23, 1898.

Subgenus *Urile*.

123a. *Phalacrocorax pelagicus robustus*. VIOLET-GREEN CORMORANT.

Yaquina Bay. Bernard J. Bretherton. "A common resident all the year, breeding on all prominent headlands."

Tillamook Co. Ellis F. Hadley. "Quite common. This and the preceding species are hated by the fishermen along the coast, for these birds will collect in bunches of from three to fifteen, and go out on the bays and fish for hours. It is said that they catch thousands of young salmon."

Family *Pelecanidæ*. Pelicans.

Genus *Pelecanus*.

Subgenus *Cyrtopelicanus*.

125. *Pelecanus erythrorhynchos*. AMERICAN WHITE PELICAN.

Dayton. Ellis F. Hadley. "A few were noted in April, 1898, migrating."

Subgenus *Leptopelicanus*.

127. *Pelecanus californicus*. CALIFORNIA BROWN PELICAN.

Yaquina Bay. Bernard J. Bretherton. "Common migrant in spring and fall."

Order Anseres. Lamellirostral Swimmers.

Family *Anatidæ*. Ducks, Geese and Swans.

Subfamily *Merginæ*. Mergansers. (Piscivorous.)

Genus *Merganser*.

129. *Merganser americanus*. AMERICAN MERGANSER.

Yaquina Bay. Bernard J. Bretherton. "Common in winter."

Scio. Dr. A. G. Prill. "Found in winter."

Elkton. Fred H. Andrus. "Common resident; breeds."

Haines, Baker Co. Robert W. Haines. "Rare."

Portland. Ross Nicholas. Willamette below Portland, Feb. 26-27, 1900.

Corvallis. A. R. W. Resident; not uncommon; female with young several days old on April 26, 1899; female with young probably two weeks old on June 1, 1901.

130. *Merganser serrator*. RED-BREASTED MERGANSER.

Yaquina Bay. Bernard J. Bretherton. "Not as common as *americanus*."

Dayton. Ellis F. Hadley. "Common in winter; arrives about October 26, and leaves about March 12."

Genus *Lophodytes*.

131. *Lophodytes cucullatus*. HOODED MERGANSER.

Yaquina Bay. Bernard J. Bretherton. "Not at all common, but a few are seen every winter."

Dayton. Ellis F. Hadley. "Not uncommon resident. Nesting in hollow trees along lakes and rivers in May."

Salem. Wm. Warner. "All the year."

Corvallis. A. R. W. Resident; not common.

Subfamily Anatinae. River Ducks. (Graminivorous, largely. Have found larvæ of caddice flies in stomachs of *Anas americana*).

Genus *Anas*.

132. *Anas boschas*. MALLARD.

Yaquina Bay. Bernard J. Bretherton. "Tolerably plentiful in fall and spring."

Dayton. Ellis F. Hadley. "Common in winter, arriving October 20, and leaving March 20. Rare resident; nesting on the ground in pastures and grain-fields."

Scio. Dr. A. G. Prill. "Constant resident; rare in summer."

Elkton. Fred H. Andrus. "Resident; breeds."

Haines. Robert W. Haines. "Common; breeds."

Portland. Ross Nicholas. Willamette below Portland; a few, February 27, 1900.

Corvallis. A. R. W. Resident; common in fall, winter and spring, uncommon in summer. The only record I have of its nesting here is of a set of ten eggs found April 25, 1898.

136. *Anas penelope*. WIDGEON.

Yaquina Bay. Bernard J. Bretherton. "Common in spring."

Dayton. Ellis F. Hadley. "Not uncommon in winter."

137. *Anas americana*. BALDPATE.

Scio. Dr. A. G. Prill. "Found in winter."

Corvallis. A. R. W. Common from the middle of September until the last of April.

139. *Anas carolinensis*. GREEN-WINGED TEAL.

Yaquina Bay. Bernard J. Bretherton. "Plentiful in winter."

Dayton. Ellis F. Hadley. "Common in winter, arrives October 15, and leaves March 10."

Scio. Dr. A. G. Prill. "Found in winter."

Haines. Robert W. Haines. "Common; breeds."

Corvallis. A. R. W. Common during winter and migrating seasons.

140. *Anas discors*. BLUE-WINGED TEAL.

Dayton. Ellis F. Hadley. "Rare migrant; one taken in February, 1896, on Willamette river."

Scio. Dr. A. G. Prill. "Found in winter."

141 *Anas cyanoptera*. CINNAMON TEAL.

Dayton. Ellis F. Hadley. "Rare migrant."

Elkton. Fred H. Andrus. "Quite common in winter."

Salem. Wm. Warner. "Rare spring migrant."

Haines. Robert W. Haines. "Common; breeds."

Genus *Spatula*.

142. *Spatula clypeata*. SHOVELLER.

Yaquina Bay. Bernard J. Bretherton. "Not at all common, but a few met with every winter."

Dayton. Ellis F. Hadley. "Rare; in winter."

Scio. Dr. A. G. Prill. "Found in winter."

Haines. Robert W. Haines. "Rare."

Corvallis. A. R. W. Winter resident; not common.

Genus *Dafila*.

143. *Dafila acuta*. PINTAIL.

Yaquina Bay. Bernard J. Bretherton. "By far the most common duck on Yaquina bay in winter, outnumbering any other species ten to one."

Dayton. Ellis F. Hadley. "Common in winter; arrives November 15; leaves February 25."

Scio. Dr. A. G. Prill. "Found in winter."

Haines. Robert W. Haines. "Rare."

Salem. Wm. Warner. "Winter resident."

Corvallis. A. R. W. Winter resident; not common.

Genus *Aix*.

144. *Aix sponsa*. WOOD DUCK.

Yaquina Bay. Bernard J. Bretherton. "A few breed on the Yaquina and Alsea rivers, but they are not common."

Dayton. Ellis F. Hadley. "Not uncommon resident, nesting in hollows in trees."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus. "Rare."

Salem. Wm. Warner. "All the year."

Corvallis. A. R. W. Resident; not uncommon along the wooded banks of our streams; breeds.

Subfamily Fuligininæ. Sea Ducks. (Coues says that the Fuligininæ "feed more upon mollusks and other animal substances than the river ducks do." In the genus *Aythya*, however, the food is more like the Anatinæ, consisting of herbage and seeds.)

Genus *Aythya*.

146. *Aythya americana*. REDHEAD.

Scio. Dr. A. G. Prill. "Found in winter."

Portland. H. T. Bohlman. Specimen taken at Ross Island, November 28, 1897.

147. *Aythya vallisneria*. CANVAS-BACK.

Yaquina Bay. Bernard J. Bretherton. "A few are shot on Yaquina Bay every season."

Dayton. Ellis F. Hadley. "Not uncommon in winter; arrives November 15; leaves February 20."

Haines. Robert W. Haines. "Rare; breeds."

Corvallis. A. R. W. Rare; hunters occasionally report killing it; have never met with it personally.

148. *Aythya marila nearctica*. AMERICAN SCAUP DUCK.

Corvallis. A. R. W. Rare; on December 27, 1899, received from a hunter an individual of this species which had been killed about ten miles south of Corvallis.

149. *Aythya affinis*. LESSER SCAUP DUCK.

Scio. Dr. A. G. Prill. "Found in winter."

Elkton. Fred H. Andrus. "Common in winter."

Dayton. Ellis F. Hadley. "Not uncommon in winter."

Portland. H. T. Bohlman. Male taken at Ross Island, Oct. 31, 1897; female, Columbia Slough, Dec. 20, 1897.

Corvallis. A. R. W. Winter resident; not common.

150. *Aythya collaris*. RING-NECKED DUCK.

Salem. Wm. Warner. "Winter resident."

Genus *Glaucionetta*.

151. *Glaucionetta clangula americana*. AMERICAN GOLDEN-EYE.

Dayton. Ellis F. Hadley. "Not rare in winter; arrives Nov. 1 and leaves March 12."

Haines. Robert W. Haines. "Rare."

Portland. H. T. Bohlman. January 25, 1895.

Genus *Charitonetta*.

153. *Charitonetta albeola*. BUFFLE-HEAD.

Yaquina Bay. Bernard J. Bretherton. "Very plentiful in fall and spring."

Genus *Clangula*.**154. *Clangula hyemalis*. OLD-SQUAW.**

Yaquina Bay. Bernard J. Bretherton. "A few seen every winter."

Genus *Histrionicus*.**155. *Histrionicus histrionicus*. HARLEQUIN DUCK.**

Yaquina Bay. Bernard J. Bretherton. "Two or three pairs seen on the ocean in March of each year."

Genus *Oidemia*.Subgenus *Oidemia*.**163. *Oidemia americana*. AMERICAN SCOTER.**

Yaquina Bay. Bernard J. Bretherton. "A rather rare winter resident."

Subgenus *Melanitta*.**165. *Oidemia deglandi*. WHITE-WINGED SCOTER.**

Yaquina Bay. Bernard J. Bretherton. "Common in winter all along the coast; the most numerous of the Surf Ducks."
Corvallis. A. R. W. Secured from a hunter a single specimen on November 4, 1900.

Subgenus *Pelionetta*.**166. *Oidemia perspicillata*. SURF SCOTER.**

Yaquina Bay. Bernard J. Bretherton. "Common in winter but not so numerous as the last."

Genus *Erismatura*.**167. *Erismatura rubida*. RUDDY DUCK.**

Yaquina Bay. Bernard J. Bretherton. "Not common."
Dayton. Ellis F. Hadley. "Rare."
Portland. Ross Nicholas. Observed eight or nine on Willamette, April 1, 1900. Killed four.
Corvallis. A. R. W. Secured a single specimen on November 7, 1900.

Subfamily Anserinæ. Geese. (The species listed below are all herbivorous.)

Genus *Chen*.**169. *Chen hyperborea*. LESSER SNOW GOOSE.**

Dayton. Ellis F. Hadley. "Rare migrant."

169a. *Chen hyperborea nivalis*. GREATER SNOW GOOSE.

Yaquina Bay. Bernard J. Bretherton. "Very numerous in the fall of 1899 and generally common during migrations."

Genus *Anser*.**171a. *Anser albifrons gambeli*. AMERICAN WHITE-FRONTED GOOSE.**

Yaquina Bay. Bernard J. Bretherton. "Common during migration."

Corvallis. A. R. W. Winter resident and fall and spring migrant.

Genus *Branta*.**172. *Branta canadensis*. CANADA GOOSE.**

Yaquina Bay. Bernard J. Bretherton. "Common during migration."

Dayton. Ellis F. Hadley. "Abundant in winter; arrives October 20 and leaves April 15."

Elkton. Fred H. Andrus.

Haines. Robert W. Haines. "Common; breeds."

Salem. Wm. Warner. "Winter resident."

Portland. H. T. Bohlman.

172a. *Branta canadensis hutchinsii*. HUTCHIN'S GOOSE.

Yaquina Bay. Bernard J. Bretherton. "Some years very numerous."

Dayton. Ellis F. Hadley. "Common in winter; generally found in bands with the Canada Goose."

Corvallis. A. R. W. Common winter resident; species other than this and the preceding (*A. a. gambeli*) are sometimes reported by hunters, but as I have not managed to secure specimens of any others for verification, have omitted them from the list of birds of this locality (Corvallis).

174. *Branta nigricans*. BLACK BRANT.

Yaquina Bay. Bernard J. Bretherton. "Commonly called 'China Goose' on Yaquina Bay and very common."

Dayton. Ellis F. Hadley. "Not uncommon during migrations; November and April."

Scio. Dr. A. G. Prill. "Found in winter."

Elkton. Fred H. Andrus. "Numerous geese pass over on spring and fall migrations, and a few remain over winter. Have had but few opportunities to identify them but am positive of the two given (*B. canadensis* and *B. nigricans*.)"

Subfamily *Cygninæ*.Genus *Olor*.**181. *Olor buccinator*. TRUMPETER SWAN.**

Dayton. Ellis F. Hadley. "Rare; seen during migrations in October and May."

Yamhill Co. Arthur L. Pope. "A bird of this species stayed for several days last winter (1894-5) on a small lake north of McMinnville."

Order Herodionæ. Herons, Storks, Ibises, etc.

Suborder Herodii. Herons, Bitterns, Egrets, etc.

Family Ardeidæ. Herons, Bitterns, etc.

Subfamily Botaurinæ. Bitterns. (Food consists of aquatic vertebrates, mollusks, and arthropods).

Genus Botaurus.

190. Botaurus lentiginosus. AMERICAN BITTERN.

Haines. Robert W. Haines. "Common; breeds."

Subfamily Ardeinæ. Herons and Egrets. (Food consists of fish, reptiles, amphibians, mollusks, and arthropods).

Genus Ardea.

Subgenus Ardea.

194. Ardea herodias. GREAT BLUE HERON.

Yaquina Bay. Bernard J. Bretherton. "A rather rare visitant not known to breed near the coast."

Dayton. Ellis F. Hadley. "Not an uncommon resident."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus. "Common resident; breeds."

Salem. Wm. Warner. "All the year."

Washington Co. A. W. Anthony. "Seen along the river below Portland and in Washington county all the year."

Portland. Ross Nicholas. Feb. 26-7, 1900, numerous; May 13, 1900, three; May 20, 1900, numerous.

Corvallis. A. R. W. Resident; not uncommon.

Subgenus Butorides.

201. Ardea virescens. GREEN HERON.

Yaquina Bay. Bernard J. Bretherton. "Common resident, breeding on Yaquina Bay."

Dayton. Ellis F. Hadley. "A common resident."

Order Paludicolæ. Cranes, Rails, etc. (Food consists largely of arthropods, mollusks and worms).

Suborder Grues. Cranes.

Family Gruidæ. Cranes.

Genus Grus.

205. Grus canadensis. LITTLE BROWN CRANE.

Washington Co. A. W. Anthony. "I think that this is the species seen so often flying south. I have only one or two records of spring migrants in Washington county, and can not say by what route they reach their northern home."

206. Grus mexicana. SANDHILL CRANE.

Dayton. Ellis F. Hadley. "Common during migration; October and April."

Corvallis. A. R. W. Spring migrant, usually observed during April; not common.

Suborder Ralli. Rails, Gallinules, Coots, etc.
 Family Rallidæ. Rails, Gallinules, and Coots.
 Subfamily Rallinæ. Rails.
 Genus *Rallus*.

212. *Rallus virginianus*. VIRGINIA RAIL.

Yaquina Bay. Bernard J. Bretherton. "Common in summer, breeding in suitable localities along the coast."

Washington Co. A. W. Anthony. "I found this species at Wapato Lake, where it was common, and I think may have bred."

Dayton. Ellis F. Hadley. "Rare resident."

Haines. Robert W. Haines. "Common; breeds."

Salem. Wm. Warner. "All the year."

Corvallis. A. R. W. Formerly a not uncommon resident of the marshes of this vicinity, nesting in April and May. Now apparently rare.

Genus *Porzana*.

Subgenus *Porzana*.

214. *Porzana carolina*. SORA.

Yaquina Bay. Bernard J. Bretherton. "One taken at Yaquina Head in the fall of 1890."

Haines. Robert W. Haines. "Common; breeds."

Subfamily Fulicinæ. Coots.

Genus *Fulica*.

221. *Fulica americana*. AMERICAN COOT.

Yaquina Bay. Bernard J. Bretherton. "Common breeding resident."

Dayton. Ellis F. Hadley. "Common resident."

Haines. Robert W. Haines. "Abundant; breeds."

Washington Co. A. W. Anthony. "Common with the above species (*Rallus virginianus*); no doubt nests in all suitable localities throughout the state."

Corvallis. A. R. W. Resident of our sloughs and other bodies of standing water; not uncommon; breeds.

Order Limicolæ. Shore Birds. (Food consists of insects, worms, mollusks and other low forms of animal life. The contents of the stomachs of *Tringa minutilla*, *Ereunetes occidentalis*, *Actitis macularia* and *Aegialitis vocifera* that I have examined consisted almost entirely of insects and their larvæ. A stomach of *Totanus flavipes* contained small fish bones).

Family Phalaropodidæ. Phalaropes.

Genus *Crymophilus*.

222. *Crymophilus fulcarius*. RED PHALAROPE.

Yaquina Bay. Bernard J. Bretherton. "Associated with the last (*Phalaropus lobatus*) occurrence about the same."

Genus *Phalaropus*.

Subgenus *Phalaropus*.

223. *Phalaropus lobatus*. NORTHERN PHALAROPE.

Yaquina Bay. Bernard J. Bretherton. "Common migrant but not numerous; flocks generally consist of from 6 to 10."

Family *Recurvirostridae*.

Genus *Recurvirostra*.

225. *Recurvirostra americana*. AMERICAN AVOCET.

Haines. Robert W. Haines. "Common; breeds."

Corvallis. A. R. W. A pair of these birds was killed about twelve miles north of Corvallis by a hunter on July 29, 1900.

Family *Scolopacidæ*. Snipes, Sandpipers, etc.

Genus *Gallinago*.

230. *Gallinago delicata*. WILSON'S SNIFE.

Dayton. Ellis F. Hadley. "Rare resident."

Yaquina Bay. Bernard J. Bretherton. "Rather rare migrant."

Scio. Dr. A. G. Prill. "Found in winter; perhaps breeds."

Elkton. Fred H. Andrus. "Have recorded this species, but am not positive of identity."

Sheridan, Yamhill Co. Arthus L. Pope. "Rare; occasionally seen in winter."

Haines. Robert W. Haines. "Common; breeds."

Salem. Wm. Warner. "Summer and breeds."

Beaverton. A. W. Anthony. "Abundant at Wapato Lake and in all suitable places in Washington county. I have heard its mating notes near Beaverton but am not sure whether it nested or not."

Corvallis. A. R. W. Common resident of our marshes and pasture lands; breeds.

Genus *Tringa*.

Subgenus *Tringa*.

234. *Tringa canutus*. KNOT.

Yaquina Bay. Bernard J. Bretherton. "A rather rare migrant."

Subgenus *Actodromas*.

239. *Tringa maculata*. PECTORAL SANDPIPER.

Salem. Wm. Warner. "Rare spring migrant."

242. *Tringa minutilla*. LEAST SANDPIPER.

Yaquina Bay. Bernard J. Bretherton. "Although this bird is not known to breed here, yet it may be met with all the time

from May to October, generally associated with the next species (*Ereunetes occidentalis*)."

Corvallis. A. R. W. Summer resident along the gravel bars of the Willamette from about the middle of April until September. Quite common, especially in the spring.

Subgenus *Pelidna*.

243a. *Tringa alpina pacifica*. RED-BACKED SANDPIPER.

Lincoln Co. The collection of Wm. Warner contains a specimen taken by Dr. Clinton T. Cooke on Beaver Creek, coast of Lincoln County, May 18, 1888.

Genus *Ereunetes*.

247. *Ereunetes occidentalis*. WESTERN SANDPIPER.

Yaquina Bay. Bernard J. Bretherton. "The commonest shore bird of the Oregon coast."

Scio. Dr. A. G. Prill. "Summer resident."

A. W. Anthony. "Common on the coast during migrations."

Corvallis. A. R. W. Very abundant in a marsh three miles north of Corvallis on April 21, 1899. In the latter part of April, 1901, I observed several small flocks of sandpipers at the same place, but as I was unable to secure specimens, am not certain whether they belonged to this species or *Tringa minutilla*.

Genus *Calidris*.

248. *Calidris arenaria*. SANDERLING.

Yaquina Bay. Bernard J. Bretherton. "Very numerous in March, April and September; more individuals associate together in one flock than in the case of any other species."

Genus *Limosa*.

249. *Limosa fedoa*. MARBLED GODWIT.

A. W. Anthony. "Common on the coast."

Genus *Totanus*.

Subgenus *Glottis*.

254. *Totanus melanoleucus*. GREATER YELLOW-LEGS.

Corvallis. A. R. W. Rather common migrant.

255. *Totanus flavipes*. YELLOW-LEGS.

Corvallis. A. R. W. Secured a single specimen on a gravel bar of the Willamette above Corvallis, July 10, 1899.

Subgenus *Helodromas*.

256a. *Totanus solitarius cinnamomeus*. WESTERN SOLITARY SANDPIPER.

Yaquina Bay. Bernard J. Bretherton. "Tolerably common during the winter months."

Genus *Heteractitis*.**259. *Heteractitis incanus*. WANDERING TATLER.**

Yaquina Bay. Bernard J. Bretherton. "A rather rare bird except on the ocean reefs and inaccessible places."

A. W. Anthony. "Quite common on the coast, inhabiting by choice, broken rocky beaches."

Genus *Actitis*.**263. *Actitis macularia*. SPOTTED SANDPIPER.**

Dayton. Ellis F. Hadley. "Common summer resident; nesting on ground under weeds or grass on a sandy island of a lake or river; four creamy eggs spotted with blackish-brown."

Elkton. Fred H. Andrus. "Resident; breeds."

Haines. Robert W. Haines. "Common; breeds."

Salem. The data of Mr. Warner's collection shows that it breeds quite extensively near Salem in the latter part of May and throughout the whole of June.

A. W. Anthony. "On the coast this species inhabits the same region as the preceding, . . . also found along fresh water streams to a greater or less extent, especially in the mountains."

Corvallis. A. R. W. Common resident—summer—of the sand and gravel bars of the Willamette river, where it breeds.

Genus *Numenius*.**264. *Numenius longirostris*. LONG-BILLED CURLEW.**

Haines. Robert W. Haines. "Common; breeds."

Grande Ronde Valley. A. W. Anthony. "I have found this species nesting in the Grande Ronde country."

265. *Numenius hudsonicus*. HUDSONIAN CURLEW.

Yaquina Bay. Bernard J. Bretherton. "Common during the fall and spring migrations, in some years very numerous, while in others quite scarce."

Wm. Warner's collection contains two specimens taken few miles south of Yaquina Bay on May 18, 1888.

Family Charadriidæ.

Genus *Charadrius*.Subgenus *Charadrius*.**272. *Charadrius dominicus fulvus*. PACIFIC GOLDEN PLOVER.**

Yaquina Bay. Bernard J. Bretherton. "The occurrence of this bird is very uncertain; it will be numerous one year and may not occur again for two or three seasons; it is, however, more often met with in the spring migration than in the fall."

Genus *Ægialitis*.Subgenus *Oxyechus*.273. *Ægialitis vocifera*. KILLDEER.

Yaquina Bay. Bernard J. Bretherton. "Sometimes met with on the ocean beach in June, July and August, and probably a few breed here."

Dayton. Ellis F. Hadley. "Not an uncommon resident; nesting on ground along streams."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus.

Haines. Robert W. Haines. "Common; breeds."

Beaverton. A. W. Anthony. "Common summer resident."

Salem. Wm. Warner. "All the year." Mr. Warner's collection contains two sets of eggs, taken near Salem, June 17, 1888, and May 16, 1891.

Portland. Ross Nicholas. "Four (4) seen on Willamette below Portland, February 27, 1900."

Corvallis. A. R. W. Resident, common; especially so in the fall and spring, and less numerous in the summer. Have found young birds in downy plumage from the middle to the last of April.

Subgenus *Ægialitis*.274. *Ægialitis semipalmata*. SEMIPALMATED PLOVER.

Yaquina Bay. Bernard J. Bretherton. "I have often seen a bird on the beach in the early fall among the flocks of Sand-
derlings that I take to be this species, but so far have been unable to obtain a specimen."

Wm. Warner's collection contains two specimens taken on the coast near Yaquina Bay in May, 1888.

278. *Ægialitis nivos*a. SNOWY PLOVER.

Columbia River. A. W. Anthony. "A plover has been described to me from the coast near the Columbia that I think can be no other species."

Family Aphrizzidæ.

Subfamily Aphrizzinæ.

Genus *Aphriza*.282. *Aphriza virgata*. SURF BIRD.

Yaquina Bay. Bernard J. Bretherton. "These beautiful sea birds are common during migrations here, frequenting the rocks and reefs in company with the next species."

A. W. Anthony. "Common for a short time only, during migrations; the species inhabits only rough rocky points along the coast, and may be easily overlooked."

Subfamily Arenariinæ.

Genus Arenaria.

283. *Arenaria interpres*. TURNSTONE.

A. W. Anthony.

284. *Arenaria melanocephala*. BLACK TURNSTONE.

A. W. Anthony. Both species of Turnstones are found together during migrations. They are found on broken rocky beaches often with the Surf Bird.

Yaquina Bay. Bernard J. Bretherton. "Although this bird does not breed here, yet they may be seen feeding on the rocks during every month of the year. Like the Surf Bird their food consists nearly entirely of decapods and mollusks, and they seem to delight in feeding where the sea spray falls over them; I have never known them to frequent the sand beaches."

Family Hæmatopodidæ. Oyster-catchers.

Genus Hæmatopus.

285. *Hæmatopus palliatus*. AMERICAN OYSTER-CATCHER.

Yaquina Bay. Dr. A. G. Prill.

287. *Hæmatopus bachmani*. BLACK OYSTER-CATCHER.

Yaquina Bay. Bernard J. Bretherton. "Common all along the Oregon coast, where they are known as Black Snipe. Breeding in June on Cape Foulweather, Otter Rock and Yaquina Head."

A. W. Anthony. "Found on the coast; no doubt it nests on some of the outlying rocks, as I have found it as far south as Mexico, nesting in May and June."

Order Gallinæ.* Gallinaceous Birds.

Suborder Phasiani. Pheasants, Grouse, Partridges, Quail, etc.

Family Tetraonidæ. Grouse, Partridges, etc.

Subfamily Perdicinæ. Partridges.

Genus Colinus.

*Several exotic species of this order are found in Oregon. Mr. Ellis F. Hadley reports the Golden Pheasant, *Chrysolophus pictus*, as a rare resident in the vicinity of Dayton. Several species of Ring Pheasants, (according to Belding, *Phasianus torquatus*, *P. sammerringtonii*, and *P. versicolor*.) were introduced to the Willamette valley from Asia a number of years ago by Judge O. N. Denny, and are commonly known as Mongolian Chinese or Denny pheasants. Taken collectively they probably outnumber, in individuals, any of the native species of gallinaceous birds in the valley. Mr. Fred H. Andrus writes that they "are becoming more common in the Umpqua valley every year." Their food consists principally of grain (oats and some wheat). Have taken specimens in which the crops were filled with seeds of cultivated peas. In the crop of a single specimen have found the bulbs of *Brodea lactea*, and in another the seeds from a coniferous tree. They destroy a considerable number of insects, principally grasshoppers (Acrididæ), and crickets (Gryllidæ). I have also found a few beetles and the adults and pupæ of cut-worms, small seeds and clover leaves in the crops.

289. *Colinus virginianus*. BOB-WHITE.

Dayton. Ellis F. Hadley. "Not uncommon resident."

Scio. Dr. A. G. Prill. "Becoming quite common."

Southern Oregon. Bendire (1877). "This species may properly be included in the avifauna of Southern Oregon. It was originally introduced at Boise City, Idaho, and now extends to the Oregon side of Snake river, and is multiplying rapidly." (L. B. P. D.)

Willamette Valley. O. B. Johnson (1880). "Introduced and doing finely." (L. B. P. D.)

Alsea Valley. G. B. Keady. Several flocks seen in August, 1900.

Corvallis. A. R. W. Heard two individuals of this species during the summer of 1899.

Genus *Oreortyx*.

292. *Oreortyx pictus*. MOUNTAIN PARTRIDGE.

Yaquina Bay. Bernard J. Bretherton. "Not at all numerous, but still common in small beavies."

A. W. Anthony. "Common in the western part of the state."

Portland. Herman T. Bohlman.

Ross Nicholas.

Dayton. Ellis F. Hadley. "Abundant resident; nests on ground in May and June; from 8 to 13 eggs."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus. "Common resident; breeds."

Salem. Wm. Warner. "All the year."

Corvallis. A. R. W. Common resident throughout the foothills and river bottoms, feeding on grain, seeds of thistles, insects, etc.

292a. *Oreortyx pictus plumiferus*. PLUMED PARTRIDGE.

Cascade Mountains. Bendire. ". . . common enough on the western slopes of the Cascade Mountains in Oregon, . . . does not seem to occur on the east side of the latter range." (L. H. N. A. B.)

Genus *Callipepla*.

Subgenus *Lophortyx*.

294. *Callipepla californica*. CALIFORNIA PARTRIDGE.

Western Oregon. Bendire. ". . . inhabitant of the coast region of California from about latitude 34° northward along the coast of Oregon to the new state of Washington . . ." (L. H. N. A. B.)

294a. *Callipepla californica vallicola*. VALLEY PARTRIDGE.

Bendire. "Drier interior valleys and foot-hills of Western Oregon. Common in the upper and middle parts of the Willamette Valley, intergrading with *californica* in the lower

portion of the valley. South of Fort Klamath on the eastern slope of the Cascades. In Southeastern Oregon, north to the northern end of Warner Valley." (L. H. N. A. B.)
Oakland (Oregon). W. E. Bryant. "Seen in breeding season." (L. B. P. D.)

Subfamily Tetraoninae.

Genus *Dendragapus*.

Subgenus *Dendragapus*.

297a. *Dendragapus obscurus fuliginosus*. SOOTY GROUSE.

Yaquina Bay. Bernard J. Bretherton. "A common breeding resident."

Dayton. Ellis F. Hadley. "Common resident; nests on ground last week in April; 6 to 10 eggs."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus. "Common resident; breeds."

Camp Harney. Capt. Bendire tells of meeting with them in numerous localities in Oregon, and has found their nests in the vicinity of Camp Harney, and killed the birds in the Cascade Mountains.

Salem. Wm. Warner. "All the year." Mr. Warner has found the eggs from the latter part of April until early in June.

Portland. H. T. Bohlman.

Minthorn. L. Rey Stryker. Set of 6 fresh eggs, taken April 27, 1893.

A. W. Anthony. "A common resident all over the western part of the state."

Corvallis. A. R. W. Resident; not uncommon. The food, as far as my limited observations go, consists of grain, herbaceous substances, as fern and young tips of the branches of coniferous trees, and some insects, spiders, etc.

297b. *Dendragapus obscurus richardsonii*. RICHARDSON'S GROUSE.

Camp Harney. Bendire. "Less abundant than var. *fuliginosus*." (L. B. P. D.)

Sparta. A. W. Anthony. "Common; nesting." (Letter of June 8, 1901.)

Genus *Bonasa*.

300a. *Bonasa umbellus togata*. CANADIAN RUFFED GROUSE.

Haines. Robert W. Haines. "Resident; common; breeds."

Fort Klamath. Bendire. "Eastern Oregon to the eastern slope of the Cascades and as far south as Fort Klamath." (L. H. N. A. B.)

300b. *Bonasa umbellus umbelloides*. GRAY RUFFED GROUSE.

Camp Harney. Bendire. "Rare resident about here, frequent-

ing densest undergrowths along the mountain streams and seldom seen." (L. B. P. D.)

300c. *Bonasa umbellus sabini*. OREGON RUFFED GROUSE.

Yaquina Bay. Bernard J. Bretherton. "Common breeding resident."

Dayton. Ellis F. Hadley. "Common resident, nesting on ground in April, May and June; 6 to 13 eggs."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus. "Common resident; breeds."

Salem. Wm. Warner. "All the year."

Wilbur. W. E. Bryant. "Summer of 1883, young and old shot." (L. B. P. D.)

Fort Klamath, 1879. Henshaw found it at Fort Klamath, although the specimens taken there are not typical *sabini*.

Camp Harney. Bendire. "Moderately common in the John Day River Valley." (L. B. P. D.)

A. W. Anthony. "Common in the western and northern part of the state—rarer in the south."

Portland. H. T. Bohlman.

Corvallis. A. R. W. Common resident. Food consists of small fruits, tender leaves, etc.

Genus *Lagopus*.

304. *Lagopus leucurus*. WHITE-TAILED PTARMIGAN.

Bendire. "In Oregon it is reported from Mounts Hood and Jefferson, and, according to Indian testimony, it occurs as far south as Diamond Peak, 60 miles north of Fort Klamath, Oregon."

Genus *Tympanuchus*.

305. *Tympanuchus americanus*. PRAIRIE HEN.

Dayton. Ellis F. Hadley. "Very rare, one killed in October, 1892."

Genus *Pediocætes*.

308a. *Pediocætes phasianellus columbianus*. COLUMBIAN SHARP-TAILED GROUSE.

Haines. Robert W. Haines. "Resident; common; breeds."

Camp Harney. Bendire. "Breeding in the sage-brush-covered plains of the Harney Valley." (L. H. N. A. B.)

Fort Klamath. Bendire. "At Fort Klamath, Oregon, where they are rather rare, I have found them inhabiting decidedly marshy and swampy country, . . . the most westerly point of its range." (L. H. N. A. B.)

A. W. Anthony. "I saw large flocks of Sharp-tailed Grouse in Eastern Washington and Oregon 15 years ago. I cannot be sure which race they were."

Genus *Centrocercus*.**309. *Centrocercus urophasianus*. SAGE GROUSE.**

Haines. Robert W. Haines. "Resident; common; breeds."

Camp Harney. Bendire. "A common resident species, particularly abundant in the upper Sylvies Valley, at an altitude of about 6000 feet." (L. B. P. D.)

"Breeds in the upper Sylvies Valley, in the Blue Mountains, migrating in the winter to the lower Harney Valley." "Oregon, east of the Cascades." A set of eggs in the Bendire collection were taken near Malheur Lake, April 4, 1877. (L. H. N. A. B.)

A. W. Anthony. "Common in all of the prairie region east of the mountains."

Order Columbæ. Pigeons.

Family Columbidae. Pigeons.

Genus *Columba*.**312. *Columba fasciata*. BAND-TAILED PIGEON.**

Yaquina Bay. Bernard J. Bretherton. "A possible thousand of these birds annually nest in the neighborhood of Yaquina Bay; they associate in small flocks of from twelve to twenty and nest in small colonies."

Dayton. Ellis F. Hadley. "Common summer resident; arrives April 20, leaves the last of November; nests in July and August in trees and bushes, generally not far from water. Nest is a mere platform of sticks and rootlets; one or two pure white eggs. Nests are often found from 10 to 20 feet up in service bushes."

Scio. Dr. A. G. Prill. "Summer resident; not common."

Elkton. Fred H. Andrus. "Summer resident; breeds. At Loon Lake near Scottsburg, I saw flocks of fully 100 birds in June, 1892. A dozen is a large flock in this locality."

Beaverton. A. W. Anthony. "First seen March 29, 1885, (ten birds); next seen March 30; April 21 common. Common in breeding season." (L. B. P. D.) "Common about Beaverton in the oak growth. No doubt nested but I have never found the nests."

Beaverton. Finley. July 1, 1898. Set of one. Fresh.

Columbia River. Captain Wm. L. Carpenter. "As far as my observation extends, this species is most numerous near the mouth of the Columbia river, where immense flocks were to be seen from May to October in 1865, which fairly rivaled those of the Passenger Pigeon," (L. H. N. A. B.)

Jacksonville. Henry E. Ankeny. "The Band-tailed Pigeon is not very common in the Rogue River Valley, Oregon, excepting when there is a good acorn crop," (L. H. N. A. B.)

Salem. Wm. Warner. "Summer and breeds."

Corvallis. A. R. W. Common summer resident from the first of April until the last of September. Frugivorous. Eat considerable quantities of wild strawberries in the spring, also the berries of haw, elder, etc.; cherries and acorns.

Genus *Zenaidura*.

316. *Zenaidura macroura*. MOURNING DOVE.

Yaquina Bay. Bernard J. Bretherton. "In August, 1898, I noticed seven doves on Cape Foulweather that I took to belong to this species."

Dayton. Ellis F. Hadley. "Common summer resident. Very rare in winter. Arrives April 15. Nests in May, June, July and August. The nest is placed on the ground, on rocks, fences, stumps, and in bushes and trees; a mere platform of a few sticks, rootlets, or straws forms the nest. Two white eggs are laid."

Scio. Dr. A. G. Prill. "Summer resident; common."

Sheridan. Arthur L. Pope. "Abundant summer resident; a few were seen last winter (1894-5)."

Elkton. Fred H. Andrus. "Summer resident; breeds."

Beaverton. A. W. Anthony. "Common summer resident. First seen April 29, 1884; rare until about June 1. First seen March 30th; 20 specimens; common April 10, 1885." (L. B. P. D.) "I find that some of the farmers complain that these birds eat wheat and other grain. I think all the wheat found in their crops is that left uncovered in the field. They are not apt to scratch out covered seed, but the vast amount of seeds of weeds consumed by this species places it high in the list of valuable birds. It should be protected at all times."

Camp Harney. Bendire. "An abundant summer resident, arriving about May 1. They rear a single brood in a season. While in Arizona I found fresh eggs as late as September 14." (L. B. P. D.)

"I found a nest of the Mourning Dove on top of an abandoned and broken-down Magpie's nest, near Camp Harney, Oregon." (L. H. N. A. B.)

Haines. Robert W. Haines. "Common; breeds."

Salem. Wm. Warner. "Summer and breeds."

Corvallis. A. R. W. Summer resident; common, at times even abundant. First arrivals seen from 9th to 13th of May; leave in September. Mr. Nicholas observed a single bird in Corvallis on February 3, 1899, the ground being lightly covered with snow at the time. Nests from the middle of May until well along in July. Eggs, usually two, sometimes one, rarely three. The Mourning Dove is a seed eater. The few crops which I have examined contained a large number of the seeds of noxious *Cruciferae* and of *Claytonia*.

Order Raptores. Birds of Prey.

Suborder Sarcorhamphi. American Vultures.

Family Cathartidæ. American Vultures.

Genus Cathartes.

325. Cathartes aura. TURKEY VULTURE.

Yaquina Bay. Bernard J. Bretherton. "A common scavenger of the ocean beach from May to September, nesting here."

Dayton. Ellis F. Hadley. "Common summer resident; arrives March 10 and leaves September 20."

Seio. Dr. A. G. Prill. "Common."

Sheridan. Arthur L. Pope. "Common summer resident."

Elkton. Fred H. Andrus. "Common summer resident; breeds."

Beaverton. A. W. Anthony. "March 22, 1885, first seen; next seen April 15; rare." (L. B. P. D.)

Camp Harney. Bendire. "Moderately common during the summer months and breeding in this vicinity. They arrive here early in April, and I saw one on the 27th of November after a fall of snow." (L. B. P. D.)

Klamath Indian Agency. Near here Captain Bendire found a nest containing two young on July 12, 1883. The nest was located in a cavity of the rocks and comparatively free from disagreeable odors.

Salem. Wm. Warner. "Summer and breeds."

Corvallis. A. R. W. Not uncommon summer resident from April to September. Feeds upon carrion and thus renders valuable service to mankind, by destroying decomposing animal matter that is not only repugnant to our senses but detrimental to health.

Suborder Falcones. Vultures, Falcons, Hawks, Buzzards, Eagles, Kites, Harriers, etc. Most of the species of this suborder are beneficial. I have had opportunity to examine but few stomachs. One of Sharp-shinned Hawk contained remains of a Junco, and one of Cooper's Hawk, the remains of a Mountain Partridge. Out of nine stomachs of Western Red-tail two were empty, three contained the remains of gallinaceous birds, one a Shore Lark, and two contained mammalian remains. A stomach of Bald Eagle contained the wool and a few ribs of a lamb. In the stomachs of the Sparrow Hawk, have occasionally found traces of mammals and sometimes beetles and spiders. The majority, however, contained grasshoppers and crickets.

Dr. A. K. Fisher in "Hawks and Owls from the Standpoint of the Farmer," divides the Raptores into four groups according to the ratio of the beneficial and harmful traits in their food habits. The two Rough-legs are classed with the entirely beneficial species, their food consisting of harmful rodents. Among the species having some harmful qualities,

but in which the beneficial traits predominate, are the Red-tails, Swainson's Hawk, Marsh Hawk and Sparrow Hawk. In the Golden and Bald Eagles, Prairie Falcon, and Merlins the harmful and beneficial qualities about balance. The Sharp-shinned, Cooper's Hawk, Goshawk and Duck Hawk are classed among the harmful species on account of their partiality to poultry and wild birds as food.

Family Falconidæ. Vultures, Falcons, Hawks, Eagles, etc.

Subfamily Accipitrinæ. Kites, Buzzards, Hawks, Goshawks, Eagles, etc.

Genus *Circus*.

331. *Circus hudsonius*. MARSH HAWK.

Willamette Valley. O. B. Johnson. "Moderately common; breeding." (L. B. P. D.)

Fort Klamath. Lieut. Wittich. "Abundant." (L. B. P. D.)

Camp Harney. Bendire. "Moderately abundant and a few resident." (L. B. P. D.)

" . . . at Camp Harney, Oregon, I have taken their eggs on April 29, 1877." (L. H. N. A. B.)

Corvallis. A. R. W. Resident; uncommon.

Genus *Accipiter*.

Subgenus *Accipiter*.

332. *Accipiter velox*. SHARP-SHINNED HAWK.

Yaquina Bay. Bernard J. Bretherton. "Not very common but occasionally met with in the heavily timbered sections."

Dayton. Ellis F. Hadley. "Rare resident; nest in fir trees from 20 to 50 feet from the ground, a platform of sticks and roots."

Scio. Dr. A. G. Prill. "Summer resident."

Sheridan. Arthur L. Pope. "Rare resident."

Elkton. Fred. H. Andrus.

Fort Klamath. Bendire. "Another set of this species was taken by me near Fort Klamath, Oregon, May 18, 1883, containing five handsome fresh eggs." (L. H. N. A. B.)

Salem. Wm. Warner. "All the year."

Beaverton. A. W. Anthony.

Corvallis. A. R. W. Resident—not common.

333. *Accipiter cooperii*. COOPER'S HAWK.

Dayton. Ellis F. Hadley. "Common resident. Nests are placed in fir trees from 40 to 90 feet from the ground; generally an old crow's nest is used. A few years ago I took a set of four eggs from an old crow's nest 85 feet up in a fir tree. Eggs are pale bluish marked with pale reddish brown."

Elkton. Fred H. Andrus. "Breeds."

Salem. Wm. Warner. "All the year."

Beaverton. A. W. Anthony. "Both species (*A. velox* and

A. cooperii) seem to be about equally common and neither are abundant in Washington County. Both are given to destroying chickens and game birds, and with the following (*A. a. striatulus*), are the only hawks found in the state that should not be fully protected. . . . "

Corvallis. A. R. W. Resident; not common.

Subgenus *Astur*.

334. *Accipiter atricapillus*. AMERICAN GOSHAWK.

Fort Klamath. Bendire. "A typical specimen of *Astur atricapillus* has, however, been taken on the eastern slopes of the Cascade Range near Fort Klamath, Oregon, by Dr. James C. Merrill, U. S. Army, on March 11, 1887, the most westerly record I know of." (L. H. N. A. B.)

334a. *Accipiter atricapillus striatulus*. WESTERN GOSHAWK.

Scio. Dr. A. G. Prill. "Summer resident; rare."

Camp Harney. Bendire. "A few pairs breed in the mountains north of Camp Harney." (L. B. P. D.)

" . . . Pretty generally distributed throughout the Blue Mountain region of Oregon and Washington . . . " (L. H. N. A. B.)

Fort Klamath. Capt. Bendire states that a pair "bred within a mile or so of Fort Klamath."

Beaverton. A. W. Anthony. "Seen once or twice in the heavy timber in Washington County; in winter more common in the mountains."

Corvallis. A. R. W. Resident, uncommon.

Genus *Buteo*.

337b. *Buteo borealis calurus*. WESTERN RED-TAIL.

Yaquina Bay. Bernard J. Bretherton. "A common and very beneficial hawk living almost entirely on *Spermophilus* and *Arvicoles* and breeding in the big timber."

Dayton. Ellis F. Hadley. "Not uncommon resident."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus. "Breeds."

Fort Klamath. Bendire. " . . . I have met with it during every winter month at Fort Klamath, Oregon, but not as frequently in the summer." (L. H. N. A. B.)

Camp Harney. Bendire. "Moderately common resident and one of the earliest hawks to breed." (L. B. P. D.)

" . . . a set of three of the Bendire collection was taken by the writer near Camp Harney, Oregon, May 29, 1877, and incubation was far advanced when found." (L. H. N. A. B.)

A. W. Anthony. "Both (*B. b. calurus* and *B. swainsoni*) are common and may be found more or less so in winter—more abundant in summer."

Haines. Robert W. Haines. "Resident, common; breeds."
 Salem. Wm. Warner.
 Portland. Ross Nicholas.
 Corvallis. A. R. W. Resident; not uncommon.

339b. *Buteo lineatus elegans*. RED-BELLIED HAWK.

Willamette Valley. O. B. Johnson. "A single example referable to this species." (L. B. P. D.)

Camp Harney. Bendire. "I met with the nest of this hawk on two occasions only, during the spring of 1878, in the vicinity of Camp Harney, Oregon, where it is a summer resident." (L. H. N. A. B.)

Subgenus *Tachytriorchis*.

342. *Buteo swainsoni*. SWAINSON'S HAWK.

Fort Klamath. Lieut. Wittich. (L. B. P. D.)

Jacksonville. W. E. Bryant. "In breeding season." (L. B. P. D.)

Camp Harney. Capt. Bendire. "A common summer resident generally distributed." (L. B. P. D.)

A. W. Anthony. "Both (*B. b. calurus* and *B. swainsoni*) are common and may be found more or less so in winter—more abundant in summer."

Genus *Archibuteo*.

347a. *Archibuteo lagopus sancti-johannis*. AMERICAN ROUGH-LEGGED HAWK.

Camp Harney. Capt. Bendire. "An irregular winter visitor; common at some seasons and entirely wanting in others." (L. B. P. D.)

"I found this species very abundant during the fall on the Umatilla Indian Reservation, and in the Harney Valley, Oregon, where they principally feed on small rodents and grasshoppers and occasionally on rabbits." (L. H. N. A. B.)

348. *Archibuteo ferrugineus*. FERRUGINOUS ROUGH-LEG.

The Dalles. Suckley, 1860. "An adult specimen taken in December, 1854, at Fort Dallas, Oregon." (L. B. P. D.)

Camp Harney. Bendire. "Rather rare but more common in the open country to the southward, particularly so near Camp McDermitt where it breeds." (L. B. P. D.)

Genus *Aquila*.

349. *Aquila chrysaetos*. GOLDEN EAGLE.

Camp Harney. Capt. Bendire. "Moderately abundant throughout the mountainous portions during the greater part of the year." (L. B. P. D.)

Captain Bendire has observed them to nest preferably in large pines or oaks, and has taken several sets laid by one pair in the vicinity of Camp Harney.

Scio. Dr. A. G. Prill. 'Secured one in October, 1901.'

Corvallis. A. R. W. A boy while hunting a short distance south of Corvallis on December 3, 1900, killed an eagle of this species while it was in the act of making an attack on his dog. Skin is now in my collection. Secured another specimen in October, 1901. This specimen was brought in by a farmer who stated that it had been taking his geese.

Genus *Haliaeetus*.

352. *Haliaeetus leucocephalus*. BALD EAGLE.

Yaquina Bay. Bernard J. Bretherton. "About ten pairs are resident here but their increase is most effectually stopped by the constant killing of young birds by local sportsmen."

Tillamook Co. Ellis F. Hadley. "Rare resident along the coast. Nests are placed in large trees and very high; from 100 to 160 feet from the ground. They feed their young on young sea-birds, mostly sea-gulls."

Scio. Dr. A. G. Prill. "Constant resident; rare."

Elkton. Fred H. Andrus. "Not common; Breeds."

Columbia River. O. B. Johnson, 1880. "Common along the Columbia River, nesting in high trees." (L. B. P. D.)

Bendire. ". . . especially common at the mouth of the Columbia River." (L. H. N. A. B.)

Klamath Lake. Bendire. "At the Klamath Lake they are especially numerous, . . . they nest . . . in Oregon and Washington, about April 1st." (L. H. N. A. B.)

Haines. Robert W. Haines. "Resident; common; breeds."

Salem. Wm. Warner.

Beaverton. A. W. Anthony. "Seen in Washington County in winter and along the Willamette and Columbia in the spring; not common."

Portland. Ross Nicholas.

Corvallis. A. R. W. For several years these birds have been reported to be wreaking havoc among the lambs south of Corvallis. Five of them were reported as seen at one time on March 1, 1900, by two reliable parties. During the remainder of the month three fell a prey to hunters, and in the early part of April numerous persons in Corvallis observed one fly over the city going westward with both of its feet ensnared in a steel-trap. Two parties have reported a nest, found about the first of June, 1900, in a tall dead tree on the Willamette about four miles above Corvallis.

Subfamily Falconinæ.

Genus *Falco*.

Subgenus *Hierofalco*.

355. *Falco mexicanus*. PRAIRIE FALCON.

Camp Harney. Bendire. "I have repeatedly seen them dur-

ing the breeding season in the Blue Mountains, near Camp Harney, as well as in the Cascade Range, near Fort Klamath, Oregon, where they nested in some of the numerous canyons, and on inaccessible cliffs abounding in these regions." (L. H. N. A. B.)

Subgenus *Rhynchodon*.

356. *Falco peregrinus anatum*. DUCK HAWK.

Camp Harney. Bendire. "A nest taken by me on April 24, 1877, from a small cavity in a basaltic cliff, 30 miles south of Camp Harney and about 3 miles from the eastern end of Malheur Lake, contained three slightly incubated eggs." (L. H. N. A. B.)

Portland. A. W. Anthony. "Seen now and then along the river below Portland."

356a. *Falco peregrinus pealei*. PEALE'S FALCON.

Yaquina Bay. Bernard J. Bretherton. "A tolerably common breeding resident, nesting on the cliffs of Cape Foulweather."

Subgenus *Esalon*.

357. *Falco columbarius*. PIGEON HAWK.

Capt. Bendire. "I have found them moderately abundant in Oregon, Washington and Idaho, and have no doubt that they regularly breed in the mountains there but the majority go farther north." (L. H. N. A. B.)

357a. *Falco columbarius suckleyi*. BLACK MERLIN.

Yaquina Bay. Bernard J. Bretherton. "A rare resident and a great enemy of all water birds."

Fort Klamath. Captain Bendire has obtained specimens in Southern Oregon at Fort Klamath.

A. W. Anthony. "Both (*F. columbarius* and *F. c. suckleyi*) are found and are about equally common, but are not abundant; generally distributed, I think."

Corvallis. A. R. W. Resident; not common.

358. *Falco richardsonii*. RICHARDSON'S MERLIN.

Captain Bendire, in his "Life Histories of North American Birds," states that there are specimens in the United States National Museum from Oregon.

Subgenus *Tinnunculus*.

360. *Falco sparverius*. AMERICAN SPARROW HAWK.

Yaquina Bay. Bernard J. Bretherton. "A common breeding resident."

Dayton. Ellis F. Hadley. "Common resident. They nest in old trees, generally in deserted Flickers' nests; no lining;

four or five very pretty pinkish-buff eggs marked with chestnut and cinnamon around the larger ends. A great bird to catch snakes."

Scio. Dr. A. G. Prill. "Constant resident."

Sheridan. Arthur L. Pope. "Common resident."

Elkton. Fred. H. Andrus. "Resident; breeds."

Camp Harney. Capt. Bendire. "Near Camp Harney, Oregon, Sparrow Hawks are very abundant, and I examined a great many of their nests, . . . the majority being placed in natural hollows or the excavations made by *Colaptes cafer* or *Melanerpes torquatus* in junipers, from five to fifteen feet from the ground." (L. H. N. A. B.)

Haines. Robert W. Haines. "Common; breeds."

Portland. H. T. Bohlman.

A. W. Anthony. "Common and well distributed."

Corvallis. A. R. W. Common resident.

Subfamily Pandioninæ.

Genus Pandion.

364. *Pandion haliaetus carolinensis*. AMERICAN OSPREY.

Yaquina Bay. Bernard J. Bretherton. "Not as common as might be expected on the sea coast; only six shot and four others seen in six years."

Dayton. Ellis F. Hadley. "A rare resident in Clackamas, Marion and Yamhill Counties. Nests are placed in trees from fifty to one hundred feet from the ground. A very bulky nest."

Scio. Dr. A. G. Prill. "Summer resident; rare."

Elkton. Fred H. Andrus. "Breeds."

Columbia River. O. B. Johnson. "Common along the Columbia and Willamette Rivers, nesting in trees." (L. B. P. D.)

Camp Harney. Bendire. "A rare summer visitor." (L. B. P. D.)

A. W. Anthony. "Common, especially along the coast."

Suborder Striges. Owls. Dr. A. K. Fisher, in "Hawks and Owls from the Standpoint of the Farmer," classes the owls as chiefly beneficial in their food habits, with the exception of the Horned Owl. In the latter the good and bad qualities about balance. I have examined a few stomachs of Dusky Horned, Barn, Saw-whet, Long-eared, Short-eared, Screech, and Burrowing Owls. They contained only mammalian remains, with the exception of the last three given. The Short-eared Owl, in addition to mice, occasionally takes a small bird. The Screech and Burrowing Owls feed largely on grasshoppers and crickets. One stomach of Screech Owl contained several dytiscid beetles and another a number of earthworms and a large myriapod.

Family Strigidæ. Barn Owls.

Genus *Strix*.**365. *Strix pratincola*. AMERICAN BARN OWL.**

Scio. Dr. A. G. Prill. "One specimen in winter."

Haines. Robert W. Haines. "Resident; common; breeds."

Corvallis. A. R. W. Mounted a specimen which was killed by hunters near the northern end of this county (Benton), on November 20, 1899.

Family Bubonidæ. Horned Owls, etc.

Genus *Asio*.**366. *Asio wilsonianus*. AMERICAN LONG-EARED OWL.**

Dayton. Ellis F. Hadley. "One killed near Dayton on November 26, 1900."

Sheridan. Arthur L. Pope. "A set of eggs of this species was taken for me last season (1894)."

Camp Harney. Bendire. "Moderately abundant and resident, frequenting the dense thickets along streams, and here constructing their own nests." (L. B. P. D.) In the "Life Histories of North American Birds," Bendire says that he found two nests near Camp Harney in April, 1877.

The Dalles. Cooper, 1860. "Obtained only once on the banks of the Columbia near the Dalles, November, 1853." (L. B. P. D.)

Haines. Robert W. Haines. "Resident; common; breeds."

Washington Co. A. W. Anthony.

Corvallis. A. R. W. Have records of three specimens killed by hunters, one on November 18 and one on December 19, 1900; one on October 29, 1901. The first and the last mentioned are in my collection.

367. *Asio accipitrinus*. SHORT-EARED OWL.

Yaquina Bay. Bernard J. Bretherton. "One specimen seen in August, 1900."

Washington Co. A. W. Anthony. "I have taken both (*A. wilsonianus* and *A. accipitrinus*) in Washington County."

Camp Harney. Bendire. "At Camp Harney, Oregon, two of their nests were found in similar situations on sidehills in the last week in May, 1876, both containing three nearly fresh eggs, and two others in the following year, on May 1st and May 4th." (L. H. N. A. B.)

Haines. Robert W. Haines. "Resident; common; breeds."

Salem. Wm. Warner. "All the year."

Corvallis. A. R. W. Common resident, frequenting marshes, waste lands and pastures.

Genus *Scotiaptex*.**370. *Scotiaptex cinerea*. GREAT GRAY OWL.**

Willamette Valley. O. B. Johnson. "Occasionally seen in heavily wooded districts." (L. B. P. D.)

Genus *Nyctala*.**372. *Nyctala acadica*. SAW-WHET OWL.**

Yaquina Bay. Bernard J. Bretherton. "Tolerably common resident in swamps and canyons."

Camp Harney. Bendire. "I have found them equally stupid in the vicinity of Camp Harney, Oregon." "One of my men also found a nest in the Blue Mountains, near Camp Harney, Oregon, May 2, 1881." (L. H. N. A. B.)

The Dalles. Suckley, 1860. "A fine specimen found at the Dalles of the Columbia in December, 1853." (L. B. P. D.)

Willamette Valley. O. B. Johnson. "I have a single example." (L. B. P. D.)

Salem. Wm. Warner. "Rare; have seen but one and that was in the mountains."

Beaverton. A. W. Anthony. "Seen once or twice at Beaverton."

Corvallis. A. R. W. Captured a specimen February 3, 1899.

Genus *Megascops*.**373c. *Megascops asio bendirei*. CALIFORNIA SCREECH OWL.**

Scio. Dr. A. G. Prill. "Constant resident."

Willamette Valley. O. B. Johnson. "Very common, breeding in trees." (L. B. P. D.)

Salem. Wm. Warner.

Corvallis. A. R. W. Resident; not uncommon; nesting in April and May. Eggs, two to four. My observations indicate that the eggs are laid at intervals of several days, as the stage of incubation of eggs found in the same nest is rarely the same.

373d. *Megascops asio kennicottii*. KENNICOTT'S SCREECH OWL.

Dayton. Ellis F. Hadley. "Common resident; eggs are placed in cavities in trees from ten to sixty feet from the ground. Very often no nest material is used; eggs are laid on rotten wood or on the moss or whatever happens to be in the cavity. I have often known a pair of these owls to either drive away or catch a squirrel and take possession of the nest themselves, where it was a hole or a hollow in a tree. Three or four white eggs are laid."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus.

Salem. Wm. Warner.

Beaverton. A. W. Anthony (Auk, April, 1886). "A not uncommon resident." (L. B. P. D.) " . . . one was taken in a steel trap set four inches below the water in a deep narrow drain. No bait was used and the bird must have struck at a fish, as I know them to eat minnows."

Portland. A. W. Anthony. "I have several times heard the love notes of this species the past February (1901) in the resi-

dence part of Portland, where the bird had taken up its residence in the thick shelter of the firs in one of the larger yards." Corvallis. A. R. W. Secured a specimen on Feb. 18, 1901.

373h. *Megascops asio macfarlanei*. MACFARLANE'S SCREECH OWL.

Southeastern Oregon. Bendire. "I found my first nest of MacFarlane's Screech Owl in Southeastern Oregon on April 16, 1877, . . . " (L. H. N. A. B.)

373—*Megascops asio saturatus*. PUGET SOUND SCREECH OWL.

Marion Co. Bendire. "In Marion County, Northwestern Oregon, nidification commences usually in the latter part of April and is frequently protracted into May." "They are constant residents in the Willamette Valley, Oregon." (L. H. N. A. B.)
Salem. Wm. Warner. "So named by Professor Baird and Captain Bendire."

374. *Megascops flammeola*. FLAMMULATED SCREECH OWL.

Haines. Robert W. Haines. "Rare, saw one specimen, June, 1893."

Genus *Bubo*.

375a. *Bubo virginianus subarcticus*. WESTERN HORNED OWL.

Yaquina Bay. Bernard J. Bretherton. "Common breeding resident in the heavily timbered sections."

Scio. Dr. A. G. Prill. "Constant resident."

A. W. Anthony.

Elkton. Fred H. Andrus. "Breeds."

Willamette Valley. O. B. Johnson. "Quite common." (L. B. P. D.)

Umatilla Indian Reservation. Bendire. "On the grassy plains in the vicinity of the Umatilla Indian Reservation, in Northwestern Oregon, I have several times seen owls of this race sitting on the little mounds in front of badger or coyote burrows, near the mouths of which small bones and pellets of fur were scattered about." (L. H. N. A. B.)

Fort Klamath. Bendire. "A few days after my arrival at Fort Klamath, Oregon (June 18, 1882), one of my men brought me a young owl of this subspecies, which he had caught alive in the pine forest south of the post." (L. H. N. A. B.)

Haines. Robert W. Haines. "Resident; common; breeds."

375c. *Bubo virginianus saturatus*. DUSKY HORNED OWL.

Dayton. Ellis F. Hadley. "Not uncommon resident."

Scio. Dr. A. G. Prill. "Constant resident."

Captain Bendire. ". . . shot quite a number of these birds in different parts of Oregon and Washington during the winter months." (L. H. N. A. B.)

Salem. Wm. Warner. "All the year."

Beaverton. A. W. Anthony. "Taken in Washington County and is no doubt the more common species in the western part of the state."

Corvallis. A. R. W. Resident; not uncommon.

Genus *Nyctea*.

376. *Nyctea nyctea*. SNOWY OWL.

Yaquina Bay. Bernard J. Bretherton. "A rare winter visitant, quite numerous in 1897."

Dayton. Ellis F. Hadley. "A rather rare winter visitor; noticed in time of snow."

Scio. Dr. A. G. Prill. "Occasional visitor."

Camp Harney. Bendire. "Rare winter visitor." (L. B. P. D.)

"I observed it on three occasions in the vicinity of Camp

Harney, Oregon, in January, 1875, and in December, 1876,

" (L. H. N. A. B.)

Willamette Valley. O. B. Johnson. "Occasionally killed in winter by hunters." (L. B. P. D.)

Corvallis. A. R. W. Sometimes taken in severe winters.

Genus *Speotyto*.

378. *Speotyto cunicularia hypogæa*. BURROWING OWL.

Scio. Dr. A. G. Prill. "Constant resident and breeds in Linn County."

The Dalles. Suckley, 1860. "Abundant at the Dalles; not seen by me west of the Cascade Mountains." (L. B. P. D.)

Camp Harney. Bendire. ". . . Oregon east of the Cascade Range of Mountains," ". . . "they appear to migrate about the beginning of November and sometimes earlier, returning to their summer homes in the early part of March."

"At Camp Harney, Oregon, where the Burrowing Owls were not very common, . . . " ". . . commences laying

. . . In Oregon, . . . rarely before the 15th of the month (April), and usually about the latter part of it." (L. H. N. A. B.)

Haines. Robert W. Haines. "Common; breeds."

Baker City. A. W. Anthony. "One seen—very likely common in this region." (Letter, June 8, 1901).

Corvallis. A. R. W. Resident; not common; have taken four specimens in the last four years.

Genus *Glaucidium*.

379. *Glaucidium gnoma*. PYGMY OWL.

Camp Harney. Captain Bendire in the "Life Histories of North American Birds," reports shooting two near Camp Harney in the winter of 1874-5 and the finding of a nest burrow by one of his men, June 10, 1883.

Fort Klamath. He also met with it on several occasions at Fort Klamath, and says that it is reported to be especially abundant at Modoc Point, Klamath Lake, Oregon, and to feed upon a lizard that is common there.

Salem. Wm. Warner. "All the year."

379a. *Glaucidium gnoma californicum*. CALIFORNIA PYGMY OWL.

Yaquina Bay. Bernard J. Bretherton. "A common resident, frequenting the neighborhood of barns and outhouses."

Dayton. Ellis F. Hadley. "Rare resident."

Sheridan. Arthur L. Pope. "Sometimes seen in the mountains."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus. "Breeds."

Willamette Valley. O. B. Johnson. "Quite common." (L. B. P. D.)

Cascade Mountains. Newberry. "I procured specimens in the Cascade Mountains in Oregon." (L. B. P. D.)

Beaverton. A. W. Anthony. "Rather common in Washington County; often seen flying about in the bright sunlight."

Benton County. Bendire. "I recently had an opportunity to examine two sets of eggs, . . . Both were collected in Benton County, Oregon, and found in woodpeckers' excavations in dead trees in swampy woods." (L. H. N. A. B.)

Corvallis. A. R. W. Resident; uncommon.

Order Coccoyges. Cuckoos, etc.

Suborder Cuculi. Cuckoos, etc. (An investigation of the food habits of the Yellow-billed Cuckoo (*C. americanus*), and the Black-billed (*C. erythrophthalmus*), by Prof. F. E. L. Beal, the results of which were published in Bulletin No. 9, Division of Biological Survey, of the U. S. Dept. of Agriculture, shows that their food consists almost entirely of insects and their larvæ, nearly all being injurious species. A little over 6 per cent of the contents of 155 stomachs consisted of beetles, about 30 per cent of grasshoppers and other Orthoptera, about 48.5 per cent of caterpillars, about 6.5 per cent of bugs, and a little over 5 per cent consisted of Diptera, Hymenoptera, etc.)

Family Cuculidae. Cuckoos, Anis, etc.

Subfamily Coccoyginae. American Cuckoos.

Genus Cocyzus.

387a *Cocyzus americanus occidentalis*. CALIFORNIA CUCKOO.

Dayton. Ellis F. Hadley. "Rather a rare summer resident in Western Oregon. Nest is placed in a tree or bush, a platform of sticks, rootlets and bark strips."

Willamette Valley. O. B. Johnson. "Rare; two specimens killed in this vicinity." (L. B. P. D.)

Keeny's Ferry. Bendire. "Keeny's Ferry, Oregon side of Snake River, August 2, 1876, a nest containing half-grown birds." (L. B. P. D.)

Salem. Wm. Warner. "Summer and breeds."

Salem. H. T. Bohlman. June 1, 1897, two sets, fresh, four and three eggs.

Suborder Alcyones. Kingfishers. (Food consists of fish and small crustaceans).

Family Alcedinidæ. Kingfishers.

Genus *Ceryle*

Subgenus *Streptoceryle*.

390. *Ceryle alcyon*. BELTED KINGFISHER.

Yaquina Bay. Bernard J. Bretherton. "Common resident, frequenting the streams and rivers in summer and resorting to the ocean beach in winter. Nests extensively in the sand cliffs directly south of the village of Newport."

Dayton. Ellis F. Hadley. "Common resident; nests are placed in excavations made by the birds in river banks, where six or eight pure white eggs are laid."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus. "Resident; breeds."

Willamette Valley. O. B. Johnson. "Constant resident." (L. B. P. D.)

Camp Harney. Bendire. "A rare summer visitor." (L. B. P. D.)

Haines. Robert W. Haines. "Resident; common; breeds."

Salem. Wm. Warner. "All the year."

Portland. Ross Nicholas.

H. T. Bohlman. Set of six, incubation begun, May 18, 1896.

A. W. Anthony. "A common summer resident along all of our streams. A few may winter but it is not common, except in summer."

Corvallis. A. R. W. Common resident nesting in June and July.

Order Pici. Woodpeckers, Wrynecks, etc. The woodpeckers are all insectivorous to a greater or less extent. The stomachs of Gairdner's and Harris's Woodpeckers which I have examined contained practically nothing but insects and their larvæ. The Red-breasted Sapsucker feeds upon insects to a large extent but frequently damages fruit and shade trees by puncturing the bark either to secure the sap which fills the pits or the insects which collect there attracted by the juices of the tree. The few stomachs of the Pileated Woodpecker examined contained the adults, larvæ and pupæ of ants, and also a large proportion of elder berries. The stomachs of Lewis's Woodpeckers contained beetles, larvæ of insects, and pieces of acorn kernels. I have on one occasion found several individuals

of this species picking and bearing away cherries. The flickers are insectivorous, but unlike the other species mentioned, which secure most of their prey from the infested wood of trees, they in addition feed to a large extent on the ground, taking a great many cut worms and other injurious terrestrial larvæ.

Family Picidæ. Woodpeckers.

Genus *Dryobates*.

393c. *Dryobates villosus harrisi* HARRIS'S WOODPECKER.

Yaquina Bay. Bernard J. Bretherton. "Frequently met with in heavy timber."

Dayton. Ellis F. Hadley. "Common resident; nests are placed in dead fir or maple trees ten to eighty feet from the ground; three or four white eggs are laid in May."

Sheridan. Arthur L. Pope. "Common resident."

Elkton. Fred H. Andrus. "Resident; breeds."

Willamette Valley. O. B. Johnson. "Common resident, breeding extensively." (L. B. P. D.)

The Dalles. Suckley, 1860. "A winter resident of Fort Dalles and Fort Steilacoom." (L. B. P. D.)

Portland. Ross Nicholas. May 13, 1900.

A. W. Anthony. "Common resident of the timbered tracts of the western part of the state."

Camp Harney. Bendire. "Sparingly distributed through the forests of the Blue Mountains in summer; in spring and fall frequent the shrubbery along creeks in the valley and a few winter in such localities." (L. H. N. A. B.)

Fort Klamath. Captain Bendire. "Among the specimens collected by me at Fort Klamath, Oregon (mostly winter birds), there are two which might be called intermediates between this and the more recently separated *D. v. hyloscopus*, but the majority are clearly referable to the latter." (L. H. N. A. B.)

Salem. Wm. Warner. "All the year." Mr. Warner's collection contains a set of eggs taken May 30, 1888; four, fresh.

Corvallis. A. R. W. Resident; not uncommon.

393d. *Dryobates villosus hyloscopus*. CABANIS'S WOODPECKER.

Camp Harney. Bendire. "I took my first nest near Camp Harney, Oregon, on May 29, 1875, in a canyon on the southern slopes of the Blue Mountains at an altitude of about 5000 feet." (L. H. N. A. B.)

Fort Klamath. Bendire. "At Fort Klamath, Oregon, it was somewhat more common and here I took several nests." (L. H. N. A. B.)

394. *Dryobates pubescens*. DOWNY WOODPECKER.

Beaverton. In the "Land Birds of the Pacific District" is mentioned a specimen shot by Mr. A. W. Anthony at Beaverton.

Fort Klamath. Bendire. "It occurs in small numbers about Fort Klamath, Oregon, where I took a set of four slightly incubated eggs, near the Indian Agency, in a dead aspen sapling, on June 9, 1883." (L. H. N. A. B.)

394a. *Dryobates pubescens gairdnerii*. GAIRDNER'S WOODPECKER.

Yaquina Bay. Bernard J. Bretherton. "By far the commonest woodpecker of the coast, being met with everywhere."

Dayton. Ellis F. Hadley. "Not uncommon resident. Nest is an excavation in a dead tree or stub, ten to twenty feet high, in which four or five white eggs are laid in May."

Elkton. Fred H. Andrus. "Resident; breeds."

Willamette Valley. O. B. Johnson. "Abundant; nesting in tops of dead willows." (L. B. P. D.)

Columbia River. Suckley, 1860. "Extremely common on the lower Columbia, especially among the willow trees." (L. B. P. D.)

Camp Harney. Bendire. "Only met in the John Day River Valley, Oregon, and it appears to be rare there." (L. B. P. D.)

Salem. Wm. Warner. "All the year." Mr. Warner's collection contained four sets of eggs all taken in May—May 4, 1888, May 12, 1889, May 15, 1891, and also one May 11, 1888. The first three mentioned sets contained five eggs each; the last set four eggs."

Portland. H. T. Bohlman.

A. W. Anthony. "Common resident of the timbered tracts of the western part of the state."

Corvallis. A. R. W. Common resident everywhere in this vicinity.

397. *Dryobates nuttallii*. NUTTALL'S WOODPECKER.

Umpqua Valley. Bendire. "In Southern Oregon it appears to be rare, and the only specimens recorded from this state are the one taken by Dr. J. S. Newberry in the Umpqua Valley, . . . and another taken near Ashland . . ." (L. H. N. A. B.)

Genus *Xenopicus*.

399. *Xenopicus albolarvatus*. WHITE-HEADED WOODPECKER.

Camp Harney. Bendire. "In the Blue Mountains, near Camp Harney, Oregon, this species was rare, but I found two nests there . . ." "Its center of abundance appears to be found in the higher Sierra Nevadas, in California, and in the Cascade Mountains, in Oregon." (L. H. N. A. B.)

Fort Klamath. Bendire. ". . . found it common at Fort Klamath in winter . . ." (L. H. N. A. B.)

Sparta. A. W. Anthony. "A few seen." (Letter of June 8, 1901).

Genus Picoides.

400. *Picoides arcticus*. ARCTIC THREE-TOED WOODPECKER.

Cascade Mountains. Bendire. ". . . abundant in the Cascade Mountains, Oregon, . . ." (L. H. N. A. B.)
 Fort Klamath. Bendire. "Dr. James C. Merrill, United States Army, found it breeding . . . near Fort Klamath, Oregon; . . ." (L. H. N. A. B.)

Genus Sphyrapicus.

402a. *Sphyrapicus varius nuchalis*. RED-NAPED SAPSUCKER.

Grant Co. Bendire. "I first met with the nest and eggs of this bird . . . near the summit of the Blue Mountains, in Grant County, Oregon, on June 12, 1877." (L. H. N. A. B.)
 Camp Harney. Bendire. "During the winter months, I have occasionally observed a Red-naped Sapsucker in the Harney Valley, in Oregon, . . ." (L. H. N. A. B.)
 Haines. Robert W. Haines. First seen January 12, 1896; next seen, January 16, 1896; last seen, April 20, 1896.

403. *Sphyrapicus ruber*. RED-BREASTED SAPSUCKER.

Dayton. Ellis F. Hadley. "Common resident; nest in an excavation in a dead tree or stub, twenty to sixty feet high; five or six white eggs are laid in April, May or June."
 Seio. Dr. A. G. Prill. "Constant resident."
 Elkton. Fred H. Andrus. "Resident; breeds."
 Salem. Bendire. "Dr. Clinton T. Cooke found the Red-breasted Sapsucker moderately common in the vicinity of Salem, Oregon, . . ." (L. H. N. A. B.)
 Wm. Warner. "All the year." Warner and Cooke's collection contained two sets of eggs taken in May, 1888.
 Beaverton. Bendire. "Mr. A. W. Anthony writes me that this species was rather common in Washington County, Oregon, in 1885." (L. H. N. A. B.)
 A. W. Anthony. "Quite common resident. Usually nests in an alder or maple along the streams, but on one occasion I found a nest 80 feet or more up in a dead fir stub."
 Fort Klamath. Bendire. "Here I found the Red-breasted Sapsucker an abundant summer resident; and I have no doubt a few of these birds winter in the more sheltered portions of the deep canyons of the Lower Klamath River region." (L. H. N. A. B.)
 Portland. H. T. Bohlman.
 Corvallis. A. R. W. Common resident.

404. *Sphyrapicus thyroideus*. WILLIAMSON'S SAPSUCKER.

Fort Klamath. Bendire. ". . . it breeds throughout the Cascade Mountains of Washington and Oregon . . ."
 "I obtained my first set of eggs of this species on June 3, 1883,

about nine miles north of Fort Klamath It consisted of five eggs slightly incubated." " it is only a summer resident in the vicinity of Fort Klamath. Its food seems to consist almost exclusively of insects and their larvæ, various species of Lepidoptera, and an occasional grasshopper." "When the young are large enough to fly they are not at all rare at the lower altitude of Fort Klamath." (L. H. N. A. B.)

Genus *Ceophloeus*.

405. *Ceophloeus pileatus*. PILEATED WOODPECKER.

Yaquina Bay. Bernard J. Bretherton. "A rather rare resident, breeding, and frequenting the large timber. The Indians believed that the red scalp of this bird was a talisman against all evil, and, in consequence, the birds were constantly hunted and their numbers greatly reduced, but as the Indians are being rapidly civilized out of existence the birds are now on the increase."

Dayton. Ellis F. Hadley. "Not common; resident mostly in the mountains; nest in high dead trees."

Sheridan. Arthur L. Pope. "Very rare in the valley. Tolerably common in the mountains. Resident."

Scio. Dr. A. G. Prill. "Constant resident; rare."

Elkton. Fred H. Andrus.

Fort Klamath. Bendire. "In the latter part of June, 1882, I found a nest containing four young about one half mile southeast from Fort Klamath, Oregon," "In the mountains of Oregon . . . the Pileated Woodpecker is most frequently met with in the extensive burnt tracts," (L. H. N. A. B.)

Willamette Valley. O. B. Johnson. "Common in heavy timbered districts." (L. B. P. D.)

Camp Harney. Bendire. "Seen but twice." (L. B. P. D.)

Salem. Wm. Warner. "All the year."

Beaverton. A. W. Anthony. "Formerly common in Washington County, but becoming rare."

Applegate River. A. W. Anthony. "I heard its notes on several occasions in early March, along the Applegate River near the California line."

Corvallis. A. R. W. Resident, uncommon, frequenting principally tall timber both in mountains and bottom lands.

Genus *Melanerpes*.

Subgenus *Melanerpes*.

407. *Melanerpes formicivorus bairdi*. CALIFORNIAN WOODPECKER.

Tillamook Co. Ellis F. Hadley. "Rare; have noted them in the Coast Mountains in Tillamook County in June and July."

Western Oregon. Bendire. " . . . rather common in many portions of California and Western Oregon." " . . .

in Oregon it rarely crosses over the eastern slopes of the Cascades" " . . . it reaches the northern limit of its range in Oregon, and it appears to be rare or entirely absent in the northwestern part of the state." (L. H. N. A. B.)

Cow Creek. A. W. Anthony. "On Cow Creek, half way between Roseburg and Grant's Pass, I found the Californian Woodpecker common in the oaks." (Per letter, June 8, 1901).

Subgenus *Asyndesmus*.

408. *Melanerpes torquatus*. LEWIS'S WOODPECKER.

Yaquina Bay. Bernard J. Bretherton. "Only noted as an occasional straggler."

Beaverton. A. W. Anthony. "Common in Washington County in summer, chiefly about the oaks."

Dayton. Ellis F. Hadley. "Not uncommon resident; nest in May and June high up in dead fir trees."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus. "Recorded while near Wilbur but not positively identified."

Columbia River. O. B. Johnson, 1880. "Common along the Columbia in winter, a few remaining to breed."

Ross Nicholas. Observed on the Columbia opposite Vancouver.

The Dalles. Henshaw, 1879. "Seen at the Dalles the last of October." (L. B. P. D.)

Camp Harney. Bendire. "A very common summer resident, breeding abundantly; arrives here about May 1, remains until the middle of October. Usual number of eggs, seven." (L. B. P. D.)

Fort Klamath. Bendire. " . . . I have found it breeding . . . at Fort Klamath and Camp Harney, Oregon."

"It is especially abundant along the eastern slopes of the Sierra Nevadas, in California and Nevada, as well as those of the Cascades in Oregon and Washington, and on both sides of the Blue Mountains, and connecting ranges in Oregon, Washington and Idaho." (L. H. N. A. B.)

Salem. Wm. Warner. "All the year."

Corvallis. A. R. W. Resident; uncommon in winter; common in summer from middle of April until October; sometimes even abundant in the spring and early summer. In the summer I have found them picking and carrying away cherries, presumably to their young. In the fall they feed extensively on acorns.

Genus *Colaptes*.

413. *Colaptes cafer*. RED-SHAFTED FLICKER.

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus.

Willamette Valley. O. B. Johnson. "Abundant; nesting, commonly." (L. B. P. D.)

Beaverton. A. W. Anthony. "Common resident; slight increase of numbers March 1, 1884." (L. B. P. D.)

Camp Harney. Bendire. "Very common, arriving the latter part of March." (L. B. P. D.)

"I found this handsome bird a common resident nearly everywhere throughout the west, from Eastern Montana west through Idaho, Oregon, Washington, and Nevada, to California, . . . " "Nidification begins about the 1st of May, and full sets of fresh eggs may be looked for about the middle of the month." "Mr. F. Stephens writes me, ' . . . it often feeds on ants and insects picked from the ground.'" "Besides the usual insects and larvæ upon which this species feeds, I have seen it catch grasshoppers, both on the ground and on the wing, and it is likewise very fond of wild strawberries and service berries." (L. H. N. A. B.)

Portland. H. T. Bohlman. Nesting May 25, 1896, and May 30, 1894.

Corvallis. A. R. W. Have but a single specimen in my collection which appears to be typical of this species, although there are several presenting intermediate gradations in intensity of coloration between this and the darker hued *saturation*, which is apparently in the majority in this locality. *Colaptes* as a genus is extremely variable, the species showing either an evidence of hybridization, or a tendency to reversion to the characters of a common ancestral form. I have one specimen of *saturation* which is marked with the red nuchal crescent of *auratus*, and another in which one half of the tail is typical while the other half has a decided yellowish cast, although not so light as in a typical specimen of *auratus*.

513a. *Colaptes cafer saturation*. NORTHWESTERN FLICKER.

Yaquina Bay. Bernard J. Bretherton. "Common resident, extremely numerous during the winter months."

Dayton. Ellis F. Hadley. "Abundant resident; nest in May and June, at all heights from the ground, in dead trees or stubs; from five to twelve eggs are laid, commonly seven or eight."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus. "We have one or the other or both of these (*C. cafer*, *C. c. saturation*); have not decided that point yet. Common resident; breeds."

Beaverton. A. W. Anthony. "Common in Washington County, and the western part of the state. A series of skins from Beaverton shows many with yellow wing and tail feathers mixed with the red."

- Haines. Robert W. Haines. "Resident, common, breeds."
 Salem. Wm. Warner. "All the year." Warner and Cooke's collection contained six sets of eggs taken throughout May and early June.
 Portland. H. T. Bohlman. Nesting May 12 to June 6.
 Ross Nicholas. Set of six, fresh, May 13, 1900.
 Corvallis. A. R. W. Very common resident, nesting in May and June.

Order Macrochires. Goatsuckers, Swifts, etc.

Suborder Caprimulgi. Goatsuckers, etc. (The birds of this suborder are all insectivorous, capturing their prey while on the wing. Among the insects taken from the crops of my specimens were dytiscid and scarabeid beetles, dragon-flies, the winged or sexual forms of termites or white ants, and several species of noctuid moths.)

Family Caprimulgidæ. Goatsuckers, etc.

Genus *Phalænoptilus*.

418. *Phalænoptilus nuttallii*. POOR-WILL.

Camp Harney. Bendire. " . . . It inhabits some of the hottest regions of the continent, . . . as well as the slopes of the Rocky and Blue Mountains in Oregon, where it reaches altitudes of from 6,000 to 8,000 feet. I have heard the Poor-will in Bear Valley, Oregon, in a locality where frost could be found every month of the year." "This species was fairly common near Camp Harney, Oregon, along the slopes of Rattlesnake Canyon, in which the post was built." (L. H. N. A. B.)
 Sp. rta. A. W. Anthony. "Common." (Letter of June 8, 1901).

Genus *Chordeiles*.

420. *Chordeiles virginianus*. NIGHTHAWK.

Fort Klamath. Bendire. "The Nighthawk was quite common along the borders of the open pine forests near Fort Klamath, . . . " (L. H. N. A. B.)

420a. *Chordeiles virginianus henryi*. WESTERN NIGHTHAWK.

Yaquina Bay. Bernard J. Bretherton. "Very numerous in summer, breeding extensively along the sea coast."
 Dayton. Ellis F. Hadley. "Common summer resident; arrives June 1, leaves August 20; nesting from June 10 to July 20."
 Sheridan. Arthur L. Pope. "Common summer resident."
 Scio. Dr. A. G. Prill. "Summer resident."
 Elkton. Fred H. Andrus. "Breeds."
 Willamette Valley. O. B. Johnson. "Common in summer, breeding on gravelly islands in Willamette River." (L. B. P. D.)

The Dalles. Suckley, 1860. "Abundant at Fort Dalles." (L. B. P. D.)

Beaverton. A. W. Anthony. "June 1, 1885, one bird, first; breeds." (L. B. P. D.)

Camp Harney. Bendire. "An exceedingly common summer resident, arriving about May 20 and leaving early in October." (L. B. P. D.)

"I found the Western Nighthawk fairly common in the vicinity of all the military posts where I have been stationed in the West, . . . A set of eggs of this subspecies was found by me on July 3, 1875, in the foothills of the Blue Mountains, some six miles northeast of Camp Harney, Oregon, laid among some pebbles on the bare ground under a little sage bush." (L. H. N. A. B.)

Haines. Robert W. Haines. "Last seen August 18; common; breeds; first seen June 4, 1897."

Salem. Wm. Warner. "Summer and breeds." Warner and Cooke's sets of Western Nighthawk were taken from June 20 until July 4.

Portland. H. T. Bohlman.

A. W. Anthony. "Common as a summer resident in all of the parts of the state I have visited."

Corvallis. A. R. W. Common summer resident, arriving from the first to the sixth of June. My latest record of this species is August 30. Nests during the latter part of June and throughout the most of July.

Suborder Cypseli. Swifts. (Insectivorous).

Family Micropodidæ. Swifts.

Subfamily Chæturinæ. Spine-tailed Swifts.

Genus Cypseloides.

422. *Cypseloides niger*. BLACK SWIFT.

Yaquina Bay. Bernard J. Bretherton. "In September, 1898, I saw a band of six swifts on Cape Foulweather that I took for this species."

Genus Chætura.

424. *Chætura vauxii*. VAUX'S SWIFT.

Dayton. Ellis F. Hadley. "Rare summer resident; arrives about May 1."

Sheridan. Arthur L. Pope. "Rare summer resident."

Beaverton. A. W. Anthony. "1884, seen several times this season. April 30, 1885, six seen; next seen May 8; common May 8; breeds." (L. B. P. D.) "Rather common in some parts of Washington County. Near Beaverton was a large hollow oak in which several pairs evidently had nests. The entrance was via the top down which the birds dashed as though shot from a gun."

Fort Klamath. Bendire. "In all of my travels through our northwestern states I have failed to see this species excepting at Fort Klamath, Oregon, where it was fairly common near Upper Klamath Lake. Dr. James C. Merrill, U. S. Army, who also met this species at the same Post, . . ."

Salem. Bendire. "Dr. C. T. Cooke writes me from Salem, Oregon, that on May 29, 1891, he discovered one of their roosting and probably also breeding trees in the Willamette Valley—a large inaccessible, dead, and hollow cottonwood, which also contained a Wood-duck's nest lower down, but likewise inaccessible." (L. H. N. A. B.)

Portland. Ross Nicholas. May 13, 1900, a few seen.

Corvallis. A. R. W. Summer resident, uncommon; have seen it on very few occasions and have taken but one specimen.

Suborder Trochili. Hummingbirds. (Feed on the nectar of flowers, and on small insects. The crops and gizzards of the Rufous hummer which I have examined—about thirty in number—always contained more or less minute beetles and aphids. On several occasions I have seen birds of this species dart from a perch on a dead limb and capture passing insects after the fashion of a flycatcher).

Family Trochilidæ. Hummingbirds.

Genus *Selasphorus*.

432. *Selasphorus platycercus*. BROAD-TAILED HUMMINGBIRD.

Camp Harney. Bendire. "In June, 1876, while en route from Camp McDermitt, Nevada, to Camp Harney, Oregon, I observed several hummingbirds among the willows beside a little brook along the southern slope of Steen's Mountain, in Southern Oregon, which I am almost certain belonged to this species, . . ." (L. H. N. A. B.)

Sparta. A. W. Anthony. "Several female hummers seen that I think were Broad-tails." (Letter of June 8, 1901).

433. *Selasphorus rufus*. RUFOUS HUMMINGBIRD.

Yaquina Bay. Bernard J. Bretherton. "Very numerous in summer, nesting everywhere."

Dayton. Ellis F. Hadley. "Abundant summer resident; arrives April 1, leaves September 1; nesting in April, May and June, in bushes, vines and trees, from two to sixty feet from the ground."

Sheridan. Arthur L. Pope. "Common summer resident."

Scio. Dr. A. G. Prill. "Summer resident."

Willamette Valley. O. B. Johnson. "Common summer resident, breeding." (L. B. P. D.)

Beaverton. A. W. Anthony. "Common summer resident; March 28, 1884, first, not again seen for some days; April 15 increasing rapidly, common April 21. May 1, first nest. In

1885, first arrived March 27; common April 3; first female April 2." (L. B. P. D.) "Nests were found in oaks, ferns and blackberry vines; their favorite site being the roots and vines along railroad cuts, where many were found."

Camp Harney. Bendire. "Rare; very few seen." (L. B. P. D.)

Table Rock. Bendire. "At Table Rock in the Cascade Mountains, they were very abundant on July 5, 1887, feeding on a Castelleja, in blossom at the time." (L. H. N. A. B.)

Portland. H. T. Bohlman. Sets of eggs taken from April 15 to May 26.

Salem. Wm. Warner. "Summer and breeds." Warner and Cooke's collection contained sets taken from April 24 until May 26.

Elkton. Fred H. Andrus. "Summer resident; breeds."

Corvallis. A. R. W. Spring and summer resident; very common; usually arrives from the third to the tenth of March, although in the year 1899 my first record of its appearance is not until March 31. The latest date on which I have noted it is August 20, but I believe it remains later.

434. **Selasphorus alleni.** ALLEN'S HUMMINGBIRD.

Dayton. Ellis F. Hadley. "Summer resident; arrives April 15 and leaves September 1; nests in May and June."

Elkton. Fred H. Andrus. "Summer resident; breeds. Have no doubt that these two are sometimes mixed in my records."

Genus *Stellula*.

436. ***Stellula calliope*.** CALLIOPE HUMMINGBIRD.

Dayton. Ellis F. Hadley. "Quite common in the Coast mountains; nests in May and June."

Fort Klamath. Bendire. " . . . Dr. James C. Merrill, United States Army, and the writer, found this Hummingbird quite common at Fort Klamath, Oregon, where I took several of its nests and eggs." (L. H. N. A. B.)

Order Passeres. Perching Birds.

Suborder Clamatores. Songless Perching Birds.

Family Tyrannidæ. Tyrant Flycatchers. (Almost entirely insectivorous taking their prey principally by darting after it from a perch. All of the birds of this Family deserve to be fully protected by law.)

Genus *Tyrannus*. (Prof. F. E. L. Beal in Farmers' Bulletin No. 54 of the U. S. Department of Agriculture, summarizes the food habits of the Kingbird (*Tyrannus tyrannus*) as follows: "Three points seem to be clearly established in regard to the food of the kingbird—(1) that about 90 per cent consists of insects, mostly injurious species; (2) that the alleged habit of preying upon honeybees is

much less prevalent than has been supposed, and probably does not result in any great damage; and (3) that the vegetable food consists almost entirely of wild fruits which have no economic value. These facts, taken in connection with its well known enmity for hawks and crows, entitle the kingbird to a place among the most desirable birds of the orchard or garden.")

444. *Tyrannus tyrannus*. KINGBIRD.

Grant Co. Bendire. ". . . rather common on the Malheur and John Day Rivers, in Grant County, Oregon, while in closely adjacent sections—as in the vicinity of Camp Harney—I failed to observe a single specimen." (L. H. N. A. B.) Grande Ronde Valley. A. W. Anthony. "I found the common eastern Kingbird very common from Grande Ronde Valley east." (Per letter of June 8, 1901.)

447. *Tyrannus verticalis*. ARKANSAS KINGBIRD.

Dayton. Ellis F. Hadley. "Rare summer resident."

Elkton. Fred H. Andrus. "Summer resident; not positively identified."

Beaverton. A. W. Anthony. "First seen May 30; again June 1, 1885. Very rare." (L. B. P. D.) "A rare summer resident about Beaverton."

Willamette Valley. O. B. Johnson. "Common in summer, breeding." (L. B. P. D.)

The Dalles. Suckley, 1860. "Fort Dalles about May 15, 1853." (L. B. P. D.)

Camp Harney. Bendire. "Common summer resident; generally distributed; arrive at Camp Harney about May 1." (L. B. P. D.)

Haines. Robert W. Haines. "Common; breeds."

Salem. Bendire. "Dr. C. T. Cooke writes me that a pair of these birds nested in the summer of 1891 in a church steeple in Salem, Oregon, . . ." (L. H. N. A. B.)

Wm. Warner. "Summer resident and breeds."

Corvallis. A. R. W. Summer resident, arriving in the latter part of April; not common. Nests on buildings, telegraph poles, windmills, and it is said in oak trees (although I have never found a nest in a tree) from the latter half of May until the first of July. I have examined but two stomachs both of which contained beetles.

448. *Tyrannus vociferans*. CASSIN'S KINGBIRD.

Beaverton. Bendire. "In Oregon it can only be considered as a rare straggler, though Mr. A. W. Anthony observed a few specimens on May 5, 1885, in Washington County, in the northwestern part of the state." (L. H. N. A. B.)

Genus *Myiarchus*.454. *Myiarchus cinerascens*. ASH-THROATED FLYCATCHER.

Camp Harney. Bendire. "I found a single nest of this species containing five young birds about ten days old, in a natural cavity in a juniper tree near Camp Harney, Oregon, on June 20, 1876, but they appear to be very rare there as no others were noticed.

"Its food consists mainly of beetles, butterflies, grasshoppers, flies, moths, and occasionally berries, . . ."
(L. H. N. A. B.)

Jacksonville. W. E. Bryant. "Breeding season of 1883."
(L. B. P. D.)

Genus *Sayornis*.457. *Sayornis saya*. SAY'S PHOEBE.

Scio. Dr. A. G. Prill.

Fort Klamath. Bendire. ". . . I took a male near Fort Klamath, Oregon, on March 28, 1883, and saw a few others subsequently . . . and I met with it also at Fort Custer, Montana; Camp Harney, Oregon; . . ." (L. H. N. A. B.)

Camp Harney. Bendire. "Rare and only found during the migrations, usually about April 1." (L. B. P. D.)

Salem. Wm. Warner. "Rare spring migrant."

Portland. H. T. Bohlman. March 28.

Corvallis. A. R. W. Rare winter resident.

458. *Sayornis nigricans*. BLACK PHOEBE.

Willamette Valley. O. B. Johnson. "A single example July, 1879." (L. B. P. D.)

Umpqua Valley. Bendire. "In southwestern Oregon it has been observed in the Umpqua Valley by Dr. J. S. Newberry; . . ." (L. H. N. A. B.)

Genus *Contopus*.Subgenus *Nuttallornis*.459. *Contopus borealis*. OLIVE-SIDED FLYCATCHER.

Dayton. Ellis F. Hadley. "Not uncommon in the Coast Mountains in Yamhill and Tillamook Counties. I collected a set of four fresh eggs June 20, 1896; nest was on a horizontal limb of a spruce tree, 15 feet from the ground. It was composed of twigs and rootlets and lined with rootlets and hair."

Willamette Valley. O. B. Johnson. "Common in summer."
(L. B. P. D.)

Beaverton. A. W. Anthony. "Common summer resident. May 11, first; bulk arrived May 22, 1884. May 5, 1885, first; May 6, next seen; common May 10. Tolerably common; breeds." (L. B. P. D.)

Camp Harney. Bendire. "A very rare summer resident."
(L. B. P. D.)

"I have met with this species . . . in the numerous parks in the Blue Mountains, where several pairs nested within a couple of miles from the post, in large spruce and pine trees which were practically inaccessible." (L. H. N. A. B.)
Salem. Wm. Warner. "Summer and breeds."

Portland. H. T. Bohlman. West of Portland Heights, May 27, 1900.

Corvallis. A. R. W. Summer resident; rare.

Subgenus *Contopus*.

462. *Contopus richardsonii*. WESTERN WOOD PEWEE.

Dayton. Ellis F. Hadley. "Common summer resident, nesting in June. I have found them nesting in tame blackberry bushes."

Elkton. Fred H. Andrus. "Common summer resident; breeds."

Beaverton. A. W. Anthony. "Common summer resident. Common May 15, 1885." (L. B. P. D.)

Willamette Valley. O. B. Johnson. "Very common in summer." (L. B. P. D.)

Camp Harney. Bendire. "Moderately common summer visitor." (L. B. P. D.)

Fort Klamath. Bendire. "In the vicinity of Fort Klamath, Oregon, where it is a common summer resident, the nests are usually placed on horizontal limbs of black pine trees, both on live and dead ones, . . ." (L. H. N. A. B.)

Portland. H. T. Bohlman. Nesting, June 29, 1898.

Ross Nicholas. First, May 13, 1900.

Salem. Wm. Warner. "Summer resident and breeds."

Corvallis. A. R. W. Common summer resident from about the middle of May until the last of August. Nests in June and first part of July.

Genus *Empidonax*.

464. *Empidonax difficilis*. WESTERN FLYCATCHER.

Fort Klamath. Bendire. " . . . near Fort Klamath, Oregon, where I found a nest containing four half-grown young . . ." (L. H. N. A. B.)

Salem. Bendire. "Dr. C. T. Cooke also found several of their nests and eggs near Salem, Oregon, in willow and cottonwood thickets." (L. H. N. A. B.)

Wm. Warner. "Summer and breeds." The sets in Warner and Cooke's collection were taken June 3 and 7, 1888.

Portland. H. T. Bohlman. 'Nesting May 9, 1897, and May 13, 1900.'

Corvallis. A. R. W. Summer resident, arriving about the 5th of May. Common in the woodlands, especially along water courses.

466. *Empidonax traillii*. TRAILL'S FLYCATCHER.

Dayton. Ellis F. Hadley. "*(E. pusillus)*. Little Flycatcher. Common summer resident, nesting in June in small bushes and weeds. Two to four feet up."

Beaverton. A. W. Anthony. "May 22, first; common June 7; in the last week in July, I found two nests and eggs on large ferns." (*E. pusillus*, L. B. P. D.)

Willamette Valley. O. B. Johnson. "Quite common in summer." (*E. pusillus*, L. B. P. D.)

Haines. Robert W. Haines. "Common; breeds." (*E. pusillus*.)

Fort Klamath. Bendire. ". . . especially common in the vicinity of Fort Klamath, Oregon, where I took a number of its nests and eggs." (*E. pusillus*, L. H. N. A. B.)

Salem. Bendire. 'Dr. Clinton T. Cooke reports it from the vicinity of Salem where it is quite common.' (*E. pusillus*, L. H. N. A. B.)

Wm. Warner. "Resident and breeds." Warner and Cooke's collection contained nearly thirty sets of eggs of this species, taken in the latter part of June and early in July. (*E. pusillus*.)

Portland. H. T. Bohlman. 'First, April 29. Nesting June 30 and July 2 and 3, 1894, and July 10 and 11, 1896.'

Corvallis. A. R. W. Summer resident; not uncommon, arriving a little later than the preceding species.

468. *Empidonax hammondi*. HAMMOND'S FLYCATCHER.

Fort Klamath.

Camp Harney. Bendire. "I have seen this species in May near Fort Klamath and Camp Harney, Oregon, but I am almost sure none remained in the vicinity to breed." (L. H. N. A. B.)

Elkton. Fred H. Andrus. "Not positively identified."

469. *Empidonax wrightii*. WRIGHT'S FLYCATCHER.

Camp Harney. Bendire. "A single specimen May 15, 1884." (L. B. P. D.)

Fort Klamath. Bendire. ". . . very common summer resident in the mountain valleys and parks of the Cascade Range, in southern Oregon, and I have found many nests of this species at Fort Klamath, also in the Des Chutes River Valley, and along the tributaries of this stream. It arrives on its breeding grounds at Fort Klamath about May 15, and nidification usually begins a month later." (L. H. N. A. B.)

Suborder Oscines. Song Birds.

Family Alaudidæ. Larks.

Genus *Alauda*.

(473.) *Alauda arvensis*. SKYLARK.

Portland. Bendire. "Introduced, though not successfully near . . . and Portland, Oregon." (L. H. N. A. B.)

Portland. H. T. Bohlman.

Genus *Otocoris*. (Food consists principally of seeds.)

474g. *Otocoris alpestris strigata*. STREAKED HORNED LARK.

Dayton. Ellis F. Hadley. "Common resident, nesting on the ground in grain-fields in May and June."

Sheridan. Arthur L. Pope. "Common resident."

Beaverton. A. W. Anthony. "Large flocks arrived April 17, 1885; a few stayed until April 30, after which I saw none." (L. B. P. D.)

Salem. Wm. Warner. "All the year."

Portland. Finley. Set of three; incubation advanced; April 29, 1893.

Corvallis. A. R. W. Resident; very common. Have taken sets of three eggs as late as the 8th of August.

474i. *Otocoris alpestris merrilli*. DUSKY HORNED LARK.

Fort Klamath. Bendire. "At Fort Klamath they were not uncommon on the gravelly prairie adjoining the Post and Dr. James C. Merrill, United States Army, found it breeding there." (L. H. N. A. B.)

Family Corvidæ. Crows, Jays, Magpies, etc.

Subfamily Garrulinæ. Magpies and Jays.

Genus *Pica*.

475. *Pica pica hudsonica*. AMERICAN MAGPIE.

Dayton. Ellis F. Hadley. "Rare in Yamhill County; have seen a few in cold spells in winter."

Scio. Dr. Prill has observed them but not identified them as to species. It can hardly be other than *P. p. hudsonica*. "Several specimens seen during winter of 1900-01."

Warner Valley. Bendire. "Mr. John Buckner, of Warner Valley, Oregon, reports having seen this species in the spring in that locality, eating the larvæ of *Hypoderma bovis*, which infests the backs of cattle, and he thinks that they also pick at the living flesh." (L. H. N. A. B.)

The Dalles. Warner and Cooke of Salem had in their collection a specimen taken at the Dalles in June, 1888.

Haines. Robert W. Haines. "Resident; common; breeds."

Forest Grove. O. B. Johnson. "Quite common in the vicinity of Forest Grove; probably breeds." (L. B. P. D.)

Fort Klamath. Lieut. Wittich. "A common species. May 12, 1878, nest with four young in a thorny bush or low tree." (L. B. P. D.)

Camp Harney. Bendire. "Not common during the summer; more abundant throughout the winter." (L. B. P. D.)

Beaverton. A. W. Anthony. "A few seen at Wapato Lake."

Genus *Cyanocitta*. (Diet consists principally of acorns, with some wheat, and insects.)

478. *Cyanocitta stelleri*. STELLER'S JAY.

Yaquina Bay. Bernard J. Bretherton. "Common breeding resident."

Dayton. Ellis F. Hadley. "Abundant resident; nesting in April and May."

Sheridan. Arthur L. Pope. "Common resident; in the summer it is more common in the mountains than in the valley."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus. "Common resident; breeds."

Fort Klamath. Bendire. ". . . quite common in the vicinity of Fort Klamath in southwestern Oregon, . . . " (L. H. N. A. B.)

Beaverton. Bendire. "Mr. A. W. Anthony writes me. 'Steller's Jay is common about Beaverton, Ore.'" (L. H. N. A. B.)

Haines. Robert W. Haines. "Resident; common; breeds."

Salem. Wm. Warner. "All the year." Warner and Cooke took a nest and four fresh eggs near Salem, Oregon, April 26, 1891.

Portland. H. T. Bohlman.

478a. *Cyanocitta stelleri frontalis*. BLUE-FRONTED JAY.

Scio. Dr. A. G. Prill. "Constant resident."

Willamette Valley. O. B. Johnson. "Abundant resident; nesting in communities." (L. B. P. D.)

Camp Harney. Bendire. "A rare resident." (L. B. P. D.)

Fort Klamath. Captain Bendire found intermediates between this and *C. stelleri* at Fort Klamath. (L. H. N. A. B.)

Corvallis. A. R. W. Very common resident; nesting in April and May. The *Cyanocitta* found here is not a typical *frontalis*, but an intermediate between *C. stelleri* and *C. s. frontalis*, and has been described under the name of *C. s. carbonacea* in No. VI, Vol. II of the Condor.

478c. *Cyanocitta stelleri annectens*. BLACK-HEADED JAY.

Blue Mountains. Bendire. "I have met with this subspecies . . . in the Blue Mountains of Oregon and Washington; . . . " (L. H. N. A. B.)

Genus *Aphelocoma*. (Food nearly identical with that of the preceding genus. Have several times observed California Jays capturing grasshoppers on the wing.)

481. *Aphelocoma californica*. CALIFORNIA JAY.

Dayton. Ellis F. Hadley. "Not uncommon resident, nesting in May . . . robbing other birds' nests."

Sheridan. Arthur L. Pope. "Not an uncommon resident."

Scio. Dr. A. G. Prill. "Constant resident."

Fort Klamath. In the "Life Histories of North American

- Birds," Captain Bendire reports having killed one and seen several pairs on May 10, 1883, thirty miles south of Fort Klamath.
- The Dalles. Henshaw reports taking a specimen at The Dalles. (L. H. N. A. B.)
- Portland. Henshaw saw eight near Portland in October, 1892. (L. H. N. A. B.)
- Wilbur. W. E. Bryant. "Breeds." (L. B. P. D.)
- Willamette Valley. O. B. Johnson. "Common among deciduous trees, breeding about habitations." (L. B. P. D.)
- Salem. Wm. Warner. "All the year." Warner and Cooke collected its nests and eggs in April.
- Portland. H. T. Bohlman.
- A. W. Anthony. "Rare in Washington County. Several were seen along the river below Portland in February and they were common the same month at Salem. Common in the southern part of the state."
- Corvallis. A. R. W. Resident; not uncommon; nesting from middle of April until last of May.

Genus Perisoreus.

484a. *Perisoreus canadensis capitalis*. ROCKY MOUNTAIN JAY.

Grant County. In the "Life Histories of North American Birds," Captain Bendire reports it rather rare in the Blue Mountains in Grant County, Oregon, and believes that to be the western limit of its range.

485. *Perisoreus obscurus*. OREGON JAY.

Dayton. Ellis F. Hadley. "Common resident of the mountains."

Scio. Dr. A. G. Prill. "Constant resident; rare."

Elkton. Fred H. Andrus. "Resident; breeds; more common in winter."

Willamette Valley. O. B. Johnson. "Common in heavy timber in winter." (L. B. P. D.)

Portland. Mr. H. T. Bohlman killed one about the middle of September, 1897, six or seven miles below Portland. On September 26, he observed a small flock of birds of this species in immature plumage, which he thinks were young.

Beaverton. A. W. Anthony. "Common February 2, when I arrived here. It appears to breed early after which it disappears. I took a nest March 31; the species was last seen April 15." (L. B. P. D.)

Clatsop County. Mr. C. W. Swallow took a set of four eggs in Clatsop County, May 8. (L. H. N. A. B.)

Camp Harney. Bendire. 'Summit of Blue Mountains, between Canyon City and Camp Harney, June 12, 1877.' (L. H. N. A. B.)

- DesChutes River. Bendire. ' . . . in a pine grove . . . '
 (L. H. N. A. B.)
 Fort Klamath. Bendire. 'A few miles north of . . . '
 (L. H. N. A. B.)

Subfamily Corvinæ.

Genus *Corvus*. (Omnivorous.)

486. *Corvus corax sinuatus*. AMERICAN RAVEN.

- Yaquina Bay. Bernard J. Bretherton. "About four pairs of Ravens breed on Cape Foulweather annually and subsist in the spring almost entirely on sea birds' eggs and young."
 Dayton. Ellis F. Hadley. "Rare."
 Scio. Dr. A. G. Prill. "Constant resident; rare."
 Elkton. Fred H. Andrus.
 Forest Grove. O. B. Johnson, 1880. "Not rare . . . "
 (L. H. N. A. B.)
 Camp Harney. Bendire. "A common resident." (L. B. P. D.)
 "I have met with them at every post at which I have been stationed in the west but nowhere so abundantly as at Camp Harney, Oregon." (L. H. N. A. B.)

488. *Corvus americanus*. AMERICAN CROW.

- Dayton. Ellis F. Hadley. "Abundant resident, nesting in April and May."
 Sheridan. Arthur L. Pope. "Abundant resident."
 Haines. Robert W. Haines. "Resident; common; breeds."
 The notes of the three above observers are on the California Crow, *C. a. hesperis*, but as the Committee of Classification and Nomenclature of the American Ornithologists Union no longer recognizes that subspecies, I have taken the liberty to include them with the observations on the American Crow.
 Camp Harney. Bendire. " . . . quite common . . . "
 (L. H. N. A. B.)
 Elkton. Fred H. Andrus. "Common resident; breeds."
 Fort Klamath. Lieut. Wittich. "Rarely seen in this region."
 (L. B. P. D.)
 Willamette Valley. O. B. Johnson. "Common resident, breeding in communities." (L. B. P. D.)
 Corvallis. A. R. W. Common resident.

489. *Corvus caurinus*. NORTHWEST CROW.

- Yaquina Bay. Bernard J. Bretherton. "A tolerably common resident."
 Dayton. Ellis F. Hadley. "Rare."
 Scio. Dr. A. G. Prill. "Constant resident."
 Salem. Wm. Warner. "All the year." Warner and Cooke collected the eggs throughout the entire month of May.

A. W. Anthony. "Not uncommon throughout the western part of the state."

Corvallis. A. R. W. Resident; common, but hardly so much so as *americanus*. A little less than half of the total number of crows of both species that I have killed have been referable to *caurinus*.

Genus *Nucifraga*.

Subgenus *Picicorvus*.

491. *Nucifraga columbiana*. CLARKE'S NUTCRACKER.

Camp Harney. Bendire. "Moderately common during the winter and spring months; none during the rest of the year; breed very early in the season. On the 5th of May, 1875, I found young birds well able to fly." "Both nests were in pine trees; one was on the extremity of a branch about twenty-five feet from the ground." (L. B. P. D.)

Captain Bendire reports flocks of them catching crickets, *Anabrus simplex*, on the southern foothills of the Blue Mountains, and also has taken their nests and eggs near Camp Harney in April. (L. H. N. A. B.)

Cascade Mountains. O. B. Johnson, 1880. "Common in the Cascade Mountains down to the foothills in winter." (L. B. P. D.)

A. W. Anthony. "Found along the Cascade Range. Common in favorable localities."

Fort Klamath. Lieut. Wittich. "They sometimes come about the quarters and keep about the kitchens." (L. B. P. D.)

Genus *Cyanocephalus*.

492. *Cyanocephalus cyanocephalus*. PINION JAY.

Des Chutes Basin. Newberry. "We first noticed this bird in the Des Chutes Basin, latitude 44° 12', in September, every morning flocks of from twenty-five to thirty, etc.; fifty miles farther north they were feeding on the berries of the Cedar, *Juniperus occidentalis*." (L. B. P. D.)

Fort Klamath. Captain Bendire reports them to be abundant on the eastern bases of the Cascades in Oregon, having seen flocks of several thousand in the open pine forests bordering the Klamath Valley. Said to breed on the head waters of the Des Chutes River. (L. H. N. A. B.)

Camp Harney. Bendire. "Late in October, 1875, about eighty; a flock flying southward."

Family Icteridæ. Blackbirds, Orioles, etc.

Genus *Dolichonyx*.

494. *Dolichonyx oryzivorus*. BOBOLINK.

Scio. Dr. A. G. Prill. "One bird only seen."

This observation was given under the head of Western

Bobolink, but as that subspecies has been eliminated from the A. U. O. "Check List of North American Birds," I have placed the record here.—A. R. W.

Genus *Molothrus*.

- 495. *Molothrus ater*. COWBIRD.** (Prof. F. E. L. Beal, in Bulletin No. 13, Division of Biological Survey, U. S. Department of Agriculture, summarizes the results of investigations of its food habits as follows: "(1) Twenty per cent of the Cowbirds' food consists of insects, which are either harmful or annoying. (2) Sixteen per cent is grain, the consumption of which may be considered a loss, though it is practically certain that half of this is waste. (3) More than 50 per cent consists of the seeds of noxious weeds, whose destruction is a positive benefit to the farmer. (4) Fruit is practically not eaten.")

Haines. Robert W. Haines. "Common; breeds."

Baker City. A. W. Anthony. "One Cowbird seen near Baker City." (Letter, June 8, 1901.)

Genus *Xanthocephalus*.

- 497. *Xanthocephalus xanthocephalus*. YELLOW-HEADED BLACKBIRD.** (Prof. F. E. L. Beal draws the following conclusion in regard to the economic status of this species. ". . . (1) that the Yellowhead feeds principally upon insects, grain, and weed seeds, and does not attack fruit or garden produce; (2) that it does much good by eating noxious insects and troublesome weeds, and (3) that where too abundant it is likely to be injurious to grain.")

Scio. Dr. A. G. Prill. "One male shot near Sweet Home, Linn County, 1893. One specimen secured near Sweet Home, Oregon, November, 1895."

Haines. Robert W. Haines. "Common; breeds."

Camp Harney. Bendire. ". . . and still more so (common) along the low, marshy shores of Lakes Malheur and Harney, in southeastern Oregon, where I have seen it in immense numbers and examined many nests." (L. H. N. A. B.)

Fort Klamath. Bendire. "It is likewise very common along the shores of Klamath Lake, and especially in the extensive Klamath marshes."

"By the middle of October they gradually disappear along the northern borders of their range, wintering in our southwestern states and in northern Mexico." (L. H. N. A. B.)

Genus *Agelaius*. (Feeds on the seeds of weeds, insects, and grain. Prof. Beal says of the Redwing, *A. phoeniceus*: "The service rendered by the destruction of noxious insects and weed seeds far outweighs the damage due to its consumption of grain. The destruction that it sometimes causes may be attributed entirely to its too great abundance in some localities.")

498. *Agelaius phoeniceus*. RED-WINGED BLACKBIRD.

- Dayton. Ellis F. Hadley. "Not uncommon in summer around swamps and marshes. Nesting in May and June."
 Elkton. Fred H. Andrus. "Not common."
 Willamette Valley. O. B. Johnson. "Very abundant in summer; breeding." (L. B. P. D.)
 Fort Klamath. Lieut Wittich. "Nesting in great numbers." (L. B. P. D.)
 Camp Harney. Bendire. "A very abundant summer visitor; some remain through the winter." (L. B. P. D.) In the "Life Histories of North American Birds," Captain Bendire reports them nesting at Camp Harney as early as March 20.
 Haines. Robert W. Haines. "Last seen September 6; common; breeds."
 Salem. Win. Warner. "All the year."
 Beaverton. A. W. Anthony. "Common at Wapato Lake; a few nest near Beaverton."
 Corvallis. A. R. W. Common resident, frequenting principally, marshes and swampy pasture lands. Nests from the first of April until the last of June.

499. *Agelaius gubernator*. BICOLORED BLACKBIRD.

- Dayton. Ellis F. Hadley. "Common resident; nesting in May and June on marshy ground, in grass or bushes one to six feet up; three or four eggs."
 Scio. Dr. A. G. Prill. "Summer resident."
 Fort Klamath. Lieut. Wittich. "Nesting in great numbers." (L. B. P. D.)
 Willamette Valley. O. B. Johnson. "Very abundant, with habits similar to *phoeniceus*." (L. B. P. D.)
 Camp Harney. Bendire. "An abundant species but less abundant than *A. phoeniceus*. The eggs of these two species present but little difference. As a general thing the eggs of this form are not marked so much, and a few are unspotted." (L. B. P. D.)
 Columbia River. Bendire. ". . . first obtained in the United States by Mr. J. K. Townsend, on the lower Columbia River, and its habitat appears to be mainly restricted to the regions west of the Cascade Mountains in Oregon and Washington." (L. H. N. A. B.)
 Portland. H. T. Bohlman. May 15, 1894.

500. *Agelaius tricolor*. TRICOLORED BLACKBIRD.

- Klamath Lake. Bendire. "Here it was first met with by Dr. J. S. Newberry, and later by Dr. James C. Merrill, United States Army, who noticed a few among the common Red-winged Blackbirds there, but did not find it breeding." (L. H. N. A. B.)

Portland. H. T. Bohlman.

Corvallis. A. R. W. I have in my collection three specimens, one male and two females, which I think are referable to this species. In all, the bills are longer, more slender and pointed, and the outlines more concave than in my specimens of *phaniceus*. In the male, however, the borders of the lesser coverts of the wings are not pure white but have a slight buffy tint on that portion of them nearest to the edge of the wing.

Genus *Sturnella*.

501b. *Sturnella magna neglecta*. WESTERN MEADOWLARK.

Yaquina Bay. Bernard J. Bretherton. "A small band annually winters here and in the spring they leave and are not seen again till fall."

Dayton. Ellis F. Hadley. "Abundant resident, nesting in April, May and June."

Sheridan. Arthur L. Pope. "Abundant resident."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus. "Common resident; breeds."

Beaverton. A. W. Anthony. "Tolerably common February 2, more plentiful March 15, 1884. A great many were frozen and drifted under in the snow storm of December 14." (L. B. P. D.) "Common, a few wintering in Washington County."

Portland. M. F. Spencer. "February 19, 1884, first song heard." (L. B. P. D.)

Ross Nicholas and H. T. Bohlman.

Willamette Valley. O. B. Johnson. "Constant resident, less common in winter." (L. B. P. D.)

Camp Harney. Bendire. "A very abundant summer visitor, breeding everywhere in low lands as well as in the highest mountain meadows. About Camp Harney they raise two or three broods in a season." (L. B. P. D.)

Haines. Robert W. Haines. "Abundant; breeds. Unusually, most of them remained last winter." (1897.)

Salem. Wm. Warner. "All the year."

Corvallis. A. R. W. Very common resident, nesting from the latter part of March until well along in June. Principally insectivorous, feeding on beetles, grubs, crickets, and cut-worms and their pupæ. Occasionally a little grain is found in the crops.

Genus *Icterus*.

Subgenus *Yphantes*.

508. *Icterus bullocki*. BULLOCK'S ORIOLE.

Dayton. Ellis F. Hadley. "Rather rare summer resident; arrives May 10, leaves September 10."

Willamette Valley. O. B. Johnson. "Summer, common; breeding extensively." (L. B. P. D.)

The Dalles. Suckley, 1860. "May 7, male specimen." (L. B. P. D.)

Camp Harney. Bendire. "Common during the summer months, arrives about May 10." (L. B. P. D.) In the "Life Histories of North American Birds," Captain Bendire tells of a pair nesting in the same tree with a Swainson's Hawk and an Arkansas Flycatcher.

Salem. Wm. Warner. "Summer resident and breeds."

Portland. H. T. Bohlman. "First seen April 27."

Ross Nicholas. "One on May 13, 1900. A dozen or more on May 20."

A. W. Anthony. "Not uncommon along the river near Portland."

Corvallis. A. R. W. Summer resident; not uncommon; arriving from May 13 to 20. Largely insectivorous.

Genus *Scolecophagus*.

510. *Scolecophagus cyanocephalus*. BREWER'S BLACKBIRD.

Yaquina Bay. Bernard J. Bretherton. "A few breed on Yaquina Bay."

Dayton. Ellis F. Hadley. "Abundant resident; nests in April and May."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus. "Common resident; breeds."

Willamette Valley. O. B. Johnson. "Very abundant in summer; breeding abundantly." (L. B. P. D.)

The Dalles. Suckley, 1860. "Quite abundant at Fort Dalles; a winter resident." (L. B. P. D.)

Camp Harney. Bendire. "An exceedingly abundant summer resident, a few remaining during mild winters. It breeds in various situations on the ground, in sage bushes, and in service-berry bushes." (L. H. N. A. B.)

Haines. Robert W. Haines. "Abundant; breeds."

Salem. Wm. Warner. "All the year."

Beaverton. A. W. Anthony. "A very abundant summer resident, and not uncommon in winter. In Washington County they nested nearly everywhere—on ditch banks, in the grass, in trees, and even in woodpecker holes 100 feet from the ground."

Portland. Ross Nicholas. Observed February 26-27, 1900.

H. T. Bohlman. Nesting May 6 and 18, 1893, and May 3 and 10, 1895.

Corvallis. A. R. W. Common resident. Nesting season begins about the middle of April. The food of the blackbird consists largely of wheat although it takes considerable insect food during the summer months.

Family Fringillidæ. Finches, Sparrows, etc.

Genus *Coccothraustes*.

Subgenus *Hesperiphona*.

514a. *Coccothraustes vespertinus montanus*. WESTERN EVENING GROSBEAK.

Dayton. Ellis F. Hadley. "Rather uncommon winter visitant; a few breed here; a set of three eggs was taken in 1898 by Louis F. Hadley, in Yamhill County."

Beaverton. A. W. Anthony. "In Washington County I saw and heard many in the tops of the tall firs but only saw one small bunch on the ground. They stayed late and I am by no means sure that they did not nest."

Scio. Dr. A. G. Prill. "Twenty-five seen December, 1900." "July, 1901. Nest and young 40 feet up in a maple tree in the city limits."

Salem. Wm. Warner. "Winter resident in the valley, but in the mountains all the year; it undoubtedly breeds as on July 4, 1890, I saw the old birds feeding the young."

Portland. H. T. Bohlman. "Large flock in City Park Mar. 21." A. W. Anthony. "Abundant in Portland in the winter and spring."

Corvallis. A. R. W. Irregular winter and spring resident. In 1899 these birds were common in Corvallis from January 27 until the middle of April when they gradually began to disappear and by the first of May all were gone. On the 25th of May, Mr. Ross Nicholas met with a large flock in the river bottom north of Corvallis. After that they were seen no more in this locality until December 31, 1900, when I recorded a single female. They became numerous about the ninth of January, 1901, and during the latter portion of that month, the whole of February, and up until the middle of March were very abundant within the city limits. Since then there has been a gradual diminution of their numbers within the corporation, due to an exodus of a portion of the birds to the outlying rural districts as their food supply diminishes. They are still (April 4) the most common species of bird in the city. The chief source of their food supply here is the samaras of the maples, the birds even eating them after germination has begun and the action of the light has produced the formation of chlorophyl in the partly unfolded cotyledons. They also feed to a small extent on the seeds of the locust and cherry, the hard shell of the latter, as well as the tough fibrous covering of the maple fruit, presenting very slight obstacles to their powerful beaks.

Some persons have expressed a fear that they would injure the buds of the fruit trees, but although I have often watched them, when they were in fruit trees, have never seen them do any damage to the buds, nor have I found anything of that nature in their crops.

Genus *Pinicola*.515. *Pinicola enucleator*. PINE GROSBEAK.

Camp Harney. Bendire. "An occasional winter visitor."
(L. B. P. D.)

(Genus *Passer*.)---. *Passer Domesticus*. EUROPEAN SPARROW.

Very common resident in all the principal cities and towns of the Willamette Valley from Corvallis to Portland.

Genus *Carpodacus*.517a. *Carpodacus purpureus californicus*. CALIFORNIA PURPLE FINCH.

Yaquina Bay. Bernard J. Bretherton. "Very numerous in spring and fall, a few pairs nesting here."

Dayton. Ellis F. Hadley. "Resident; nests in June; very bad to pull off the blossoms and young fruit."

Scio. Dr. A. G. Prill. "Seen December, 1900."

Beaverton. A. W. Anthony. "Abundant summer resident; March 6, first; March 20, 1884, common; April 1, bulk arrived; February 20, 1885, ten birds; next seen February 23; common March 27. Very common; breeds." (L. B. P. D.) "Abundant in Washington County, and only departing for a short time in winter. They are said to destroy a large amount of fruit by cutting the blossoms, but I regard the damage as greatly overestimated. A few cherry trees that were badly cut by them while in blossom, and seemingly ruined, were later broken by the weight of fruit."

Willamette Valley. O. B. Johnson. "Common summer resident." (L. B. P. D.)

Salem. Wm. Warner. "Summer and breeds."

Portland. H. T. Bohlman.

Ross Nicholas. Feb. 27 and May 20, 1900.

Corvallis. A. R. W. Resident; not uncommon. Very abundant during March, April, and the early part of May, when they sometimes become a nuisance by reason of their picking the blossoms from the cherry trees, and to some extent from the prune. The object of these depredations is to secure the young ovary from the blossom. In plucking the latter, it is seized by the calyx tube, wrenched from its pedicle and cut into in the region of the ovary, the bird sometimes securing the latter organ and sometimes not. Not infrequently trees in Corvallis are fairly stripped by these birds. During the summer and fall they feed upon the seeds of wild mustard, rape, cabbage and asparagus. In winter they may be found around apple orchards feeding on the seeds of apples which have fallen to the ground and decayed. In the spring they feed extensively on the seed of chickweed. This plant was

so abundant during the spring of 1901, that the birds rarely molested the cherry blossoms. I believe that they destroy enough of the seeds of noxious Cruciferae and other weedy plants to more than make recompense for the damage that they do to the fruit trees. Nest in June.

518. *Carpodacus cassinii*. CASSIN'S PURPLE FINCH.

Camp Harney. Bendire. "Moderately abundant summer visitor; breeds in the pine forests of the Blue Mountains. It is probable that some remain throughout mild winters." (L. B. P. D.)

Subgenus *Burrica*.

519. *Carpodacus mexicanus frontalis*. HOUSE FINCH.

Camp Harney. Bendire. "April 8, 1876, a single specimen." (L. B. P. D.)

Dayton. Ellis F. Hadley. "Rare, have seen a few in early spring."

Elkton. Fred H. Andrus. "Not positively identified."

Genus *Loxia*.

521. *Loxia curvirostra minor*. AMERICAN CROSSBILL.

Yaquina Bay. Bernard J. Bretherton. "Very numerous in some winters but entirely absent in others."

Dayton. Ellis F. Hadley. "Rare in winter."

Scio. Dr. A. G. Prill. "Large numbers seen, 1891."

Willamette Valley. O. B. Johnson. "Common in the mountains and coming down to the valley in winter." (L. B. P. D.)

Camp Harney. Bendire. "Common during the winter months in large flocks." (L. B. P. D.)

Beaverton. A. W. Anthony. "Not uncommon at times in Washington County. That is they were seen—possibly the same flock—on many occasions."

Salem. Wm. Warner. "All the year in the mountains."

Holbrook. H. T. Bohlman. "Killed female from flock feeding on dried hemlock berries, April 22, 1900."

522. *Loxia leucoptera*. WHITE-WINGED CROSSBILL.

Beaverton. A. W. Anthony. "During a heavy storm in 1884 I thought I saw two or three but am by no means sure."

Genus *Leucosticte*.

524. *Leucosticte tephrocotis*. GRAY-CROWNED LEUCOSTICTE.

Camp Harney. Bendire. "A winter visitor, associated with *L. littoralis*, from November 8, 1875, to March 22, 1876. Specimens at different times." (L. B. P. D.)

524a. *Leucosticte tephrocotis littoralis*. HEPBURN'S LEUCOSTICTE.

Camp Harney. Bendire. (Birds Southeastern Oregon.) "I have observed these birds almost daily for two winters, and examined about two hundred specimens. It is probable that some breed on high peaks." (L. B. P. D.)

*Genus *Acanthis*.

528. *Acanthis linaria*. REDPOLL.

Camp Harney. Bendire. "Found in large flocks during winter." (L. B. P. D.)

Fort Klamath. Lieut. Wittich. ("Bull. Nutt. Orn. Club, IV.) May 9, 1878." (L. B. P. D.)

Corvallis. A. R. W. On January 20, 1900, I met with a flock of about one hundred and fifty birds a short distance northwest of Corvallis. Secured specimens.

Genus *Spinus*. (The birds of this genus feed almost entirely on the seeds of various *Compositae*. The favorite food of the goldfinches as well as the siskins, appears to be the seeds of one of the sundials, *Senecio vulgaris*. The goldfinches feed extensively on the seeds of thistles, tarweed, dandelions, and to a small extent on lettuce. They also feed, to a less extent, on the seeds of chickweed and rape. One crop of an American Goldfinch, taken with a set of eggs, contained aphids exclusively.)

529. *Spinus tristis*. AMERICAN GOLDFINCH.

Dayton. Ellis F. Hadley. "Common summer resident; arrives April 15 and leaves September 20; a few remain during the winter; nest in June and July."

Sheridan. Arthur L. Pope. "Common summer resident."

Elkton. Fred H. Andrus. "Common summer resident; breeds."

Willamette Valley. O. B. Johnson. "Common summer resident." (L. B. P. D.)

Beaverton. A. W. Anthony. "February 20, 1884, ten seen; next seen, February 23; common, March 27; very common in breeding season. April 18, 1885, first; common May 5; breeds. Very common." (L. B. P. D.) "I think that the thistle seeds as well as other seeds eaten by this species, render it of more than passing value to the farmer."

Camp Harney. Bendire. "Seen on but a single occasion, May 5, 1876." (L. B. P. D.)

Salem. Wm. Warner. "Summer and breeds."

Portland. H. T. Bohlman. "June 22 and July 12, 1895, two sets; fresh."

Ross Nicholas. Observed May 13 and 20, 1900.

Corvallis. A. R. W. Resident. Very common from April 1

until October 15; not uncommon during March; small bands occasionally seen during January and February. It is not recorded in my notes during the months of November and December. Nests in June and the first half of July.

529a. *Spinus tristis pallidus*. WESTERN GOLDFINCH.

Yaquina Bay. Bernard J. Bretherton. "Very common summer resident."

Scio. Dr. A. G. Prill. "Summer resident."

Portland. H. T. Bohlman. "First pairs seen on April 26. July 12, 1896, set of four; fresh."

(The A. O. U. Check List of North American Birds limits the range of *pallidus* to Arizona. Probably these are *S. tristis*.)

530. *Spinus psaltria*. ARKANSAS GOLDFINCH.

Dayton. Ellis F. Hadley. "Not uncommon in summer; arrives April 1, leaves November 1; nest in April, May and June. I collected a set of four eggs, incubation begun, in April, 1896, from a nest twenty feet up in a large fir tree."

Elkton. Fred H. Andrus. "Twice this fall (1900) I saw what I took to be this species but am not positive."

Salem. Wm. Warner. "Summer resident and breeds."

Corvallis. A. R. W. Resident. Not uncommon during the summer from the latter part of March until the last of September; not common during the winter.

533. *Spinus pinus*. PINE SISKIN.

Dayton. Ellis F. Hadley. "Common in winter."

Beaverton. A. W. Anthony. "March 14, 1885, first; March 15, common; last seen April 30." (L. B. P. D.) "Common as a migrant in Washington county."

Willamette Valley. O. B. Johnson, 1880. "Common winter resident." (L. B. P. D.)

Camp Harney. Bendire. "Common during the winter months in the Blue Mountains." (L. B. P. D.)

Salem. Wm. Warner. "All the year and breeds very early."

Portland. H. T. Bohlman. "Very numerous April 25."

Ross Nicholas. "Flock on Dec. 13, 1899. Quite a number on May 13, 1900."

Corvallis. A. R. W. Fall, winter, and spring resident from early part of October until last of May or first of June. Usually very abundant. During the spring of 1899, flocks of from two to four hundred were no uncommon sight. During the past fall and winter, however, I have seen only two small flocks, one on October 14, 1900, the other January 17, 1901. Common during the spring and fall of 1901.

Genus *Plectrophenax*.534. *Plectrophenax nivalis*. SNOWFLAKE.

Yaquina Bay. Bernard J. Bretherton. "Two or three specimens taken every winter."

Camp Harney. Bendire. "Found sparingly during the winter months." (L. B. P. D.)

Genus *Calcarius*.536. *Calcarius lapponicus*. LAPLAND LONGSPUR.

Camp Harney. Bendire. "Found sparingly during the winter months." (L. B. P. D.)

Genus *Poocætes*. (The food of the vesper sparrows consists of beetles and the larvæ of insects together with about an equal amount of vegetable matter. A small proportion of the latter is usually wheat, but the greater part consists of the seeds of weedy plants.)

540a. *Poocætes gramineus confinis*. WESTERN VESPER SPARROW.

Willamette Valley. O. B. Johnson. "Common during the summer." (L. B. P. D.)

Beaverton. A. W. Anthony. "Common summer resident; April 5, 1884, May 1, abundant." (L. B. P. D.)

Camp Harney. Bendire. "Very common summer resident, breeding abundantly." (L. B. P. D.)

Salem. Wm. Warner. "Summer resident and breeds."

540b. *Poocætes gramineus affinis*. OREGON VESPER SPARROW.

Dayton. Ellis F. Hadley. "Common summer resident; arrives April 1st."

Beaverton. A. W. Anthony. "Common summer resident in Washington County."

Sheridan. Arthur L. Pope. "Common summer resident."

Salem. Wm. Warner. "Summer and breeds."

Portland. Ross Nicholas. Feb. 27 and May 20, 1900.

Corvallis. A. R. W. Summer resident; common, April to October, inclusive. Rarely seen in winter.

Genus *Ammodramus*. (I have had an opportunity to examine the stomachs of a few specimens each of the Sandwich Sparrow, and the Western Savanna Sparrow. The stomachs of fifteen specimens of the former species contained vegetable matter almost exclusively. A very small portion consisted of grain, it being principally the seeds of uncultivated plants. One stomach contained insects.

The stomachs of the Western Savanna Sparrow were principally filled with insects although a small quantity of seeds were found. The difference in the contents of

the stomachs of the two species was undoubtedly due to the fact that my specimens of the former were taken early in the spring migration, when insect life was scarce, while my specimens of the latter species were taken in summer when insects were much more abundant.)

Subgenus *Passerculus*.

542. *Ammodramus sandwichensis*. SANDWICH SPARROW.

Willamette Valley. O. B. Johnson. "Seen sparingly during the migrations." (L. B. P. D.)

Salem. Wm. Warner's collection contains two specimens taken April 16, 1891.

Beaverton. A. W. Anthony. "A few taken in early spring in Washington County."

Corvallis. A. R. W. Abundant during the migrations, especially in the spring.

542b. *Ammodramus sandwichensis alaudinus*. WESTERN SAVANNA SPARROW.

Yaquina Bay. Bernard J. Bretherton. "Common breeding resident seen in great numbers on Cape Foulweather."

Dayton. Ellis F. Hadley. "Rare migrant."

Camp Harney. Bendire. "Very common in the early spring." (L. B. P. D.)

Salem. Wm. Warner.

Beaverton. A. W. Anthony. "Rather rare as a migrant."

Corvallis. A. R. W. Common summer resident from April 1 until the middle of October.

Subgenus *Centronyx*.

545. *Ammodramus bairdii*. BAIRD'S SPARROW.

Camp Harney. Bendire. "May 24, 1876, I took a nest and eggs with parent, which I identified as this species." (L. B. P. D.)

Subgenus *Coturniculus*.

546a. *Ammodramus savannarum perpallidus*. WESTERN GRASSHOPPER SPARROW.

Dayton. Ellis F. Hadley. "Rare migrant."

Salem. Warner and Cooke's collection contained a specimen taken on May 4, 1888.

Genus *Chondestes*.

552a. *Chondestes grammacus strigatus*. WESTERN LARK SPARROW.

Dayton. Ellis F. Hadley. "Not uncommon summer resident; arrives April 15, leaves September 15; nests on the ground in May and June."

Elkton. Fred H. Andrus. "Am not positive of identity."

Willamette Valley. O. B. Johnson. "Sparingly common during the summer." (L. B. P. D.)

The Dalles. Suckley, 1860. "One specimen at Fort Dalles;
 . . . " (L. B. P. D.)

Camp Harney. Bendire. "In the immediate vicinity of Camp Harney, few specimens; at Juniper Lake, 80 miles south, quite a number breeding." (L. B. P. D.)

Jacksonville. A. W. Anthony. "Seen in region of Jacksonville in early March, 1901."

Corvallis. A. R. W. Summer resident; not common. Arrives from the 3d to the 10th of April, remaining until about the middle of September. Nests in June. Have found three nests, all in apple trees at heights of from four to eight feet from the ground. Eggs three to four, bluish white with a few dots and long irregular lines of black.

Genus *Zonotrichia*. (Principally herbivorous. Sometimes stomachs contain seeds.)

554. *Zonotrichia leucophrys*. WHITE-CROWNED SPARROW.

Scio. Dr. A. G. Prill. "Summer resident."

Fort Klamath. "Wittich, Nutt. Bull., IV, 165. Numerous; specimens April 26, 1875, April 29, 1878." (L. B. P. D.)

Yaquina Bay. Warner and Cooke's collection contained a set of eggs with one of parents, taken at Newport, Oregon.

554a. *Zonotrichia leucophrys intermedia*. INTERMEDIATE SPARROW.

Camp Harney. Bendire. "A moderately abundant summer resident." (L. B. P. D.)

Portland. Ross Nicholas. May 20, 1900.

Corvallis. A. R. W. One specimen taken and several more seen during the spring migration of 1901.

554b. *Zonotrichia leucophrys gambelii*. GAMBEL'S SPARROW.

Yaquina Bay. Bernard J. Bretherton. "A very abundant summer resident, breeding here."

Dayton. Ellis F. Hadley. "Abundant summer resident, arrives April 1, leaves October 1; nests all summer."

Sheridan. Arthur L. Pope. "Abundant in summer; a few stay over winter."

Elkton. Fred H. Andrus. "Common summer resident; breeds."

Butteville, Oregon. W. E. Bryant. "In breeding season of 1883" (L. B. P. D.)

Portland. H. T. Bohlman. Nesting May 6-11, 1894, May 11, 1895, and May 13, 1900.

Willamette Valley. O. B. Johnson. "A very common summer resident and nesting familiarly about gardens and thickets near dwellings." (L. B. P. D.)

Beaverton. A. W. Anthony. "Common summer resident, April 7, first; April 12, bulk arrived; May 12, first nest. First seen March 25, five birds; common March 30, 1885." (L. B. P. D.)

Fort Dalles. Suckley, 1860. "Very abundant at Fort Dalles and Puget Sound, a constant summer resident at both places." (L. B. P. D.)

Salem. Warner and Cooke collected the birds at Salem and also numerous sets of eggs during May and early June.

Corvallis. A. R. W. Not common throughout most of the year. Common during last of March and entire month of April. Nests throughout May, June, and the first part of July.

557. *Zonotrichia coronata*. GOLDEN-CROWNED SPARROW.

Yaquina Bay. Bernard J. Bretherton. "Very numerous in spring migration and a few remain all summer."

Dayton. Ellis F. Hadley. "Abundant winter resident; arrives September 25, leaves May 1."

Willamette Valley. O. B. Johnson. "Sparingly common during summer." (L. B. P. D.)

Beaverton. A. W. Anthony. "One specimen as late as May 22, 1884, but mostly gone by May 1." (L. B. P. D.) "Very common during the migration but passes rapidly. Does not stop in Washington County for any length of time."

The Dalles. Suckley, 1860. "Not rare in the vicinity of Fort Dalles or Fort Steilacoom; in both places quite abundant in summer." (L. B. P. D.)

Salem. Wm. Warner. "Winter resident."

Portland. H. T. Bohlman.

Corvallis. A. R. W. Resident. Not uncommon. Very abundant during last part of March, April and early May; also during September and October.

Genus *Spizella*.

559a. *Spizella monticola ochracea*. WESTERN TREE SPARROW.

Camp Harney. Bendire. "Moderately abundant during the winter months." (L. B. P. D.)

560a. *Spizella socialis arizonæ*. WESTERN CHIPPING SPARROW.

Yaquina Bay. Bernard J. Bretherton. "Two specimens taken May 13, 1896, no others seen."

Dayton. Ellis F. Hadley. "Abundant summer resident; arrives April 15, leaves September 20; nests in May and June."

Sheridan. Arthur L. Pope. "Common summer resident."

Scio. Dr. A. G. Prill. "Summer resident."

Portland. H. T. Bohlman. "First seen April 15. Nesting June 16, 1892, May 29 and June 3, 1895, and May 15 and 19, 1897."

Ross Nicholas. Observed May 20, 1900.

Elkton. Fred H. Andrus. "Common summer resident; breeds."

Beaverton. A. W. Anthony. "Common summer resident. April 17, 1884, first; rare until the 25th, about which time

the bulk arrived. First seen March 30, one bird; common May 15, 1885." (L. B. P. D.)

Salem. Wm. Warner. "Summer and breeds."

Corvallis. A. R. W. Very common summer resident from the first of April until the last of September. Nests from the middle of May until the last of June. The food of this species, aside from a small quantity of weed seed consumed, consists of insects, mostly small beetles, various larvæ and aphids. During the summer of 1900 they fed very extensively on the larvæ of a cutworm moth, *Peridroma saucia*, which was then very abundant and destructive. Once observed feeding on Tent Caterpillars, *Clisiocampa constricta*.

562. *Spizella breweri*. BREWER'S SPARROW.

Camp Harney. Bendire. "Common summer resident; breeds abundantly amongst the sage-brush-covered plains." (L. B. P. D.)

563a. *Spizella pusilla arenacea*. WESTERN FIELD SPARROW.

Dayton. Ellis F. Hadley. "Rare in summer; a nest containing three incubated eggs was found on June 14, 1900, under a bunch of briars in a pasture."

Genus Junco.

567. *Junco hyemalis*. SLATE-COLORED JUNCO.

Corvallis. A. R. W. Saw a single bird of this species with a flock of *J. h. oregonus* on November 23, 1899. On January 13, 1900, secured a specimen which was in company with a large flock of *oregonus*.

567a. *Junco hyemalis oregonus*. OREGON JUNCO.

Yaquina Bay. Bernard J. Bretherton. "Common but not numerous in winter."

Dayton. Ellis F. Hadley. "Common resident; abundant in winter; nests in April, May and June."

Sheridan. Arthur L. Pope. "Abundant resident."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus. "Common resident; breeds; most numerous in winter."

Beaverton. A. W. Anthony. "Abundant resident; first nest and eggs April 20." (L. B. P. D.)

Willamette Valley. O. B. Johnson. "Abundant during winter; a few remain to breed." (L. B. P. D.)

Camp Harney. Bendire. "Winter resident, retiring to the neighboring mountains in summer." (L. B. P. D.)

Salem. Wm. Warner. "All the year and breeds plentifully in the mountains." The Warner and Cooke collection contained a set of five eggs, taken on May 7, 1888, in South Salem.

Portland. Ross Nicholas. 'December 13, 1899, numerous; January 21, 1900, one; February 27, 1900, numerous; May 20, 1900, two.'

H. T. Bohlman. Nesting May 9 and 15, 1894; May 4, 1895. May 6, 1900.

Corvallis. A. R. W. Very abundant fall, winter and spring resident, first arrivals appearing from September 17 to October 1. The last ones leave in the spring about the last of April. Occasionally seen during the summer in small numbers in the foothills west of Corvallis. Feeds on seeds of weeds and to a less extent on insects.

Genus *Amphispiza*.

574a. *Amphispiza belli nevadensis*. SAGE SPARROW.

Camp Harney. Bendire. "A not very abundant summer resident; none remain through the winter." (L. B. P. D.)

Genus *Melospiza*.

581b. *Melospiza fasciata montana*. MOUNTAIN SONG SPARROW.

Camp Harney. Bendire. "The race found here, a resident, partly at least." (L. B. P. D.)

Linkville. Warner and Cooke's collection contained two specimens taken at Linkville, May 27, 1888.

581c. *Melospiza fasciata guttata*. RUSTY SONG SPARROW.

Yaquina Bay. Bernard J. Bretherton. "Abundant breeding resident, more numerous in winter than in summer."

Dayton. Ellis F. Hadley. "Abundant resident; nests all summer."

Sheridan. Arthur L. Pope. "Very common summer resident; not uncommon in winter."

Portland. H. T. Bohlman. Nesting June 6 and 27, 1894.

Ross Nicholas. Observed February 27 and May 13 and 20, 1900.

Beaverton. A. W. Anthony. "Very common resident in Washington County."

Scio. Dr. A. G. Prill. "Summer resident."

Elkton. Fred H. Andrus. "Common resident; breeds."

Willamette Valley. O. B. Johnson. "Plentiful permanent resident." (L. B. P. D.)

Camp Harney. Bendire. "In December, 1875, I took two specimens, perhaps the true *guttata*." (L. B. P. D.)

Salem. Wm. Warner. "All the year."

Corvallis. A. R. W. Common resident; nesting from the latter part of April until about the middle of July. Food consists of small seeds together with insects.

581f. *Melospiza fasciata rufina*. SOOTY SONG SPARROW.

Corvallis. A. R. W. Two specimens; one taken January 4, 1899; one December 27, 1899.

583. *Melospiza lincolni*. LINCOLN'S SPARROW.

Rattlesnake Creek. Bendire. "Noticed in considerable numbers on their way north in the spring of 1876 on Rattlesnake Creek. A few remain to breed." (L. B. P. D.)

Dayton. Ellis F. Hadley. "Rare."

Salem. Wm. Warner. "Rare summer resident."

Corvallis. A. R. W. Rare spring migrant. Observed twice and one specimen taken.

Genus *Passerella*.

585a. *Passerella iliaca unalaschcensis*. TOWNSEND'S SPARROW.

Dayton. Ellis F. Hadley. "Not uncommon in winter; arrives October 1, leaves May 1."

Willamette Valley. O. B. Johnson. "Only a winter visitor." (L. B. P. D.)

Beaverton. A. W. Anthony. "Common at Beaverton as a winter resident. It flocks with the song sparrow or is found alone in the thick undergrowth."

Salem. Warner and Cooke collected twenty-three specimens from February 26 until April 12, 1891.

Yaquina Bay. Bernard J. Bretherton. "Common in early spring and fall."

Corvallis. A. R. W. Have observed a few several times during winter and early spring and taken two specimens.

585c. *Passerella iliaca schistacea*. SLATE-COLORED SPARROW.

Camp Harney. Bendire. "A common summer visitor; arrives about April 1. I have found some twenty nests within half a mile of the Post." (L. B. P. D.)

Genus *Pipilo*.

588. *Pipilo maculatus arcticus*. ARCTIC TOWHEE.

Corvallis. A. R. W. Have in my collection one specimen of this species taken on January 20, 1899.

588b. *Pipilo maculatus oregonus*. OREGON TOWHEE.

Yaquina Bay. Bernard J. Bretherton. "Common resident; undoubtedly breeds here."

Dayton. Ellis F. Hadley. "Abundant resident; nests in May."

Sheridan. Arthur L. Pope. "Very common resident."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus. "Common resident; breeds."

Willamette Valley. O. B. Johnson. "A common constant resident." (L. B. P. D.)

Beaverton. A. W. Anthony. "Common resident." (L. B. P. D.)
 Wilbur. W. E. Bryant. "Adult and young specimens." (L. B. P. D.)

Salem. Wm. Warner. "All the year."

Portland. H. T. Bohlman and Ross Nicholas.

Corvallis. A. R. W. Common resident, nesting in the latter part of May and in June. Diet, largely wheat in winter, but most of this is probably waste taken from barnyards where most of my specimens of this species were secured. Also mast, seeds, and other vegetable matter, together with insects, slugs, etc.

590. *Pipilo chlorurus*. GREEN-TAILED TOWHEE.

Fort Klamath. Lieut. Wittich. "Summer." (L. B. P. D.)

Camp Harney. Bendire. "Moderately abundant during the summer." (L. B. P. D.)

591b. *Pipilo fuscus crissalis*. CALIFORNIA TOWHEE.

Corvallis. A. R. W. Have met with this species in small numbers a few times in July and August. Have secured but one specimen.

Genus *Habia*.

596. *Habia melanocephala*. BLACK-HEADED GROSBEAK.

Dayton. Ellis F. Hadley. "Common summer resident; arrives May 20, leaves September 15; nests in June and July."

Elkton. Fred H. Andrus. "Summer resident; breeds."

Willamette Valley. O. B. Johnson. "Common summer resident; breeding numerously." (L. B. P. D.)

Camp Harney. Bendire. "Rare summer visitor; begins to breed about June 1." (L. B. P. D.)

Salem. Wm. Warner. "Summer resident and breeds."

Portland. Ross Nicholas. May 20, 1900.

Beaverton. A. W. Anthony. "Rare in Washington County. A few seen in maple and alder groves."

Corvallis. A. R. W. Summer resident, appearing during the latter half of May; not uncommon. Nests in June. Almost entirely insectivorous.

Genus *Passerina*.

599. *Passerina amoena*. LAZULI BUNTING.

Dayton. Ellis F. Hadley. "Common summer resident; arrives May 10, leaves September 1; nests in June."

Sheridan. Arthur L. Pope. "Common summer resident."

Scio. Dr. A. G. Prill. "Summer resident."

Elkton. Fred H. Andrus. "Common summer resident; breeds."

Willamette Valley. O. B. Johnson. "Abundant during summer; breeding plentifully." (L. B. P. D.)

The Dalles. Suckley, 1860. "The specimen I shot at the Dalles was obtained from a flock of several hundred individuals which had just arrived from the south in spring." (L. B. P. D.)

Camp Harney. Bendire. "A rare summer visitor; a pair or so breed." (L. B. P. D.)

Beaverton. A. W. Anthony. "First seen May 21, 1885; again May 23." (L. B. P. D.) "Very common summer resident."

Salem. Wm. Warner. "Summer resident and breeds."

Corvallis. A. R. W. Common summer resident, the first arrivals appearing from the 3d to the 12th of May, and nesting from early in June until about the 15th of July. Very largely insectivorous.

Family Tanagridæ. Tanagers. (Insectivorous and Frugivorous.)
Genus *Piranga*.

607. *Piranga ludoviciana*. LOUISIANA TANAGER.

Dayton. Ellis F. Hadley. "Common summer resident; arrives May 15, leaves September 1."

Sheridan. Arthur L. Pope. "Tolerably common summer resident."

Scio. Dr. A. G. Prill. "Summer resident."

Elkton. Fred H. Andrus. "Summer resident; breeds."

Beaverton. A. W. Anthony. "May 14, 1885, six specimens; common May 20; not uncommon summer resident." (L. B. P. D.)

Willamette Valley. O. B. Johnson. "Common summer resident." (L. B. P. D.)

Salem. Wm. Warner. "Summer resident; also breeds."

Portland. Ross Nicholas. Male seen May 20, 1900.

Mr. Finley found it nesting on June 10-28, 1894, and 11-20, 1895.

Corvallis. A. R. W. Common summer resident, first putting in its appearance between the seventh and twelfth of May.

Family Hirundinidæ. Swallows. (Insectivorous.)
Genus *Progne*.

611a. *Progne subis hesperia*. WESTERN MARTIN.

Portland. H. T. Bohlman.

Ross Nicholas. One on May 13, 1900.

Fulton. Finley. Set of 5, fresh, July 3, 1895.

Beaverton. A. W. Anthony. "Only a few seen about Beaverton."

Corvallis. A. R. W. Mr. Nicholas observed a pair of these birds about 12 miles south of Corvallis on April 27, 1899. A few days later one of them was killed and sent to him.

Genus Petrochelidon.

612. Petrochelidon lunifrons. CLIFF SWALLOW.

Dayton. Ellis F. Hadley. "Common summer resident; arrives April 10; leaves September 1; nests in June and July."

Scio. Dr. A. G. Prill. "Summer resident."

Elkton. Fred H. Andrus. "Common summer resident; breeds."

Beaverton. A. W. Anthony. "I think it came March 26 with *T. thalassina*, but not recognized until common." (L. B. P. D.) 'Abundant.'

Willamette Valley. O. B. Johnson. "Abundant in summer; breeding chiefly under eaves." (L. B. P. D.)

Fort Dalles. Suckley, 1860. "Moderately abundant; makes its appearance in spring simultaneously with *T. bicolor* and *T. thalassina*, but is not so numerous." (L. B. P. D.)

Camp Harney. Bendire. "One of the most abundant summer residents." (L. B. P. D.)

Haines. Robert W. Haines. 'First seen May 6, 1897, 20 birds; next seen May 12; common May 12; abundant; breeds.'

Portland. Finley. Two sets of four and five eggs; June 20, 1894; fresh.

Corvallis. A. R. W. Common summer resident and breeds plentifully.

Genus Chelidon.

613. Chelidon erythrogastra. BARN SWALLOW.

Yaquina Bay. Bernard J. Bretherton. "Common summer resident, breeding here."

Dayton. Ellis F. Hadley. "Rare summer resident, nesting in May and June."

Scio. Dr. A. G. Prill. "Summer resident."

Elkton. Fred H. Andrus. "Summer resident; not common; breeds."

Beaverton. A. W. Anthony. "May 2, 1884, first, and occasionally afterward. The only one seen in 1885 was on May 12." (L. B. P. D.)

Camp Harney. Bendire. "A few pairs breed about the buildings of the Post. They arrive about the same time (May 1) but remain much longer than the Cliff Swallow, which leaves about the middle of August." (L. B. P. D.)

Haines. Robert W. Haines. 'May 6, 1897, 20 birds; next seen May 8; common May 8. Abundant; breeds.'

Corvallis. A. R. W. Summer resident; uncommon.

Genus Tachycineta.

614. Tachycineta bicolor. TREE SWALLOW.

Dayton. Ellis F. Hadley. "Rare summer resident; nests in June."

Beaverton. A. W. Anthony. "Common summer resident. Arrived April 4, two birds; common April 15, 1885." (L. B. P. D.)

Willamette Valley. O. B. Johnson. "Abundant; nesting in holes in trees." (L. B. P. D.)

The Dalles. Suckley, 1860. "Obtained both at Fort Steilacoom and Fort Dalles." (L. B. P. D.)

Salem. Wm. Warner. "Summer resident; breeds."

Portland. Ross Nicholas. February 27, 1900, observed 8 or 10. Killed 2 on Willamette below Portland.

H. T. Bohlman, May 16, 1900. Set of 5 on Columbia Slough. Incubation slightly begun.

Corvallis. A. R. W. Spring and summer resident; not common.

615. *Tachycineta thalassina*. VIOLET-GREEN SWALLOW.

Yaquina Bay. Bernard J. Bretherton. "Abundant summer resident; breeds here."

Dayton. Ellis F. Hadley. "Common summer resident; arrives March 20, leaves September 20. Nests in May and June."

Sheridan. Arthur L. Pope. "Abundant summer resident."

Scio. Dr. A. G. Prill. "Summer resident."

Beaverton. A. W. Anthony. "Common summer resident. March 26, first; bulk arrived April 5, 1884. In 1885, first arrived March 13, five birds; common March 25." (L. B. P. D.)

Willamette Valley. O. B. Johnson. "Abundant; nesting in knot-holes and crevices about buildings; decidedly the most familiar of the three species of swallows." (L. B. P. D.)

Bear Creek. Bendire. "Noted on Bear Creek, Blue Mountains, summer of 1876." (L. B. P. D.)

Salem. Wm. Warner. "Summer resident and breeds."

Elkton. Fred H. Andrus. "Common summer resident; breeds."

Stilla. H. T. Bohlman. 'First April 2; common April 15; nesting May 19 to July 4.'

Ross Nicholas. Observed May 20, 1900.

Corvallis. A. R. W. Very common spring and summer resident, first making its appearance between the 12th and 18th of March, and remaining well along into October. Nests in May.

Genus *Clivicola*.

616. *Clivicola riparia*. BANK SWALLOW.

Dayton. Ellis F. Hadley. "Common summer resident; arrives May 10, leaves September 10; nests in June."

Sheridan. Arthur L. Pope. "Common summer resident."

Elkton. Fred H. Andrus. "Rare summer resident; breeds."

Malheur Lake. Bendire. "Breeds in large numbers on one of the islands in Malheur Lake." (L. B. P. D.)

Corvallis. A. R. W. Summer resident; not common.

Genus *Stelgidopteryx*.**617. *Stelgidopteryx serripennis*. ROUGH-WINGED SWALLOW.**

Yaquina Bay. Bernard J. Bretherton. "Summer resident, nesting in the sand cliffs all along the coast."

Salem. Wm. Warner. "Summer resident, and breeds in banks of the river and creeks."

Willamette River. H. T. Bohlman. Nesting May 20th and June 1, 2, 3, 1897.

Corvallis. A. R. W. Uncommon summer resident.

Family Ampelidæ. Waxwings, etc.

Subfamily Ampelinæ. Waxwings.

Genus *Ampelis*.

618. *Ampelis garrulus*. BOHEMIAN WAXWING.

Camp Harney. "Captain Bendire (Birds S. E. Or.) Just noticed November 23, 1875. Quite a number were secured between November and March 1." (L. B. P. D.)

Forest Grove. O. B. Johnson. "I obtained a pair of these beautiful birds during a snowstorm in January, 1876, at Forest Grove." (L. B. P. D.)

Haines. Robert W. Haines. 'Rare; thirty or forty seen January 10, 1897.'

Salem. Wm. Warner. "Rare winter migrant."

619. *Ampelis cedrorum*. CEDAR WAXWING.

Dayton. Ellis F. Hadley. "Common summer resident; arrives May 20, leaves September 1; nests in June and July." Sheridan. Arthur L. Pope. "Tolerably common summer resident."

Scio. Dr. A. G. Prill. "Summer resident."

Elkton. Fred H. Andrus. "Have several records of this species."

Beaverton. A. W. Anthony. "Common summer resident. First seen May 22; common by June 7, 1884. April 20, 1885, first seen; common April 24. Breeds." (L. B. P. D.)

Willamette Valley. O. B. Johnson. "Abundant summer resident." (L. B. P. D.)

Salem. Wm. Warner. "Summer resident and breeds here."

Portland. Mr. Finley found it nesting June 8, 1895.

Corvallis. A. R. W. Summer resident from early in May until the latter part of October; very common. Nests in June and first part of July. The Cedar Waxwing, or Cherry Bird, has earned an unenviable reputation on account of its fondness for that fruit. Prof. F. E. L. Beal, in Farmers' Bulletin No. 54, U. S. Department of Agriculture, says that an examination of 152 stomachs showed 13 per cent of animal matter, consisting principally of noxious insects, and 87 per cent of

vegetable food. Thirteen per cent of the year's food consisted of cultivated fruit and only 5 per cent of cherries. Only 9 stomachs, out of 41 collected in June and July, contained cultivated cherries. On comparison of the above data it can readily be seen that the beneficial traits of this species greatly outweigh the amount of damage done to the cherries and other cultivated fruits.

Family Laniidæ. Shrikes. (Carnivorous, the food consisting of small mammals, insects, and birds.)

Genus *Lanius*.

621. *Lanius borealis*. NORTHERN SHRIKE.

Willamette Valley. O. B. Johnson. "Quite common resident." (L. B. P. D.)

Camp Harney. Bendire. "Rare winter visitor." (L. B. P. D.)

Salem. Wm. Warnef. "Winter resident found only in very stormy weather."

Portland. Mr. H. T. Bohlman secured a specimen at Ross Island, January 3, 1898.

Corvallis. A. R. W. Rare winter visitant.

622a. *Lanius ludovicianus excubitorides*. WHITE-RUMPED SHRIKE.

Sparta. A. W. Anthony. "A shrike was very common on the sage plains between Sparta and Baker City. I think that it was *excubitorides*, but can not be sure." (Letter of June 8, 1901.)

Corvallis. A. R. W. Late fall, winter and spring resident; uncommon. Have never observed it in summer.

622b. *Lanius ludovicianus gambeli*. CALIFORNIA SHRIKE.

Camp Harney. Bendire. "A common summer visitor and generally distributed. They arrive here about the 20th of March." (L. B. P. D.)

Sheridan. Arthur L. Pope. "Rare; I have seen it several times in the mountains in summer."

Family Vireonidæ. Vireos. (Insectivorous.)

Genus *Vireo*.

Subgenus *Vireosylva*.

627. *Vireo gilvus*. WARBLING VIREO.

Dayton. Ellis F. Hadley. "Common summer resident; arrives May 1, leaves September 1; nests in June."

(The above note was given under the head of *V. g. swainsoni*, but as that subspecies is not recognized by the A. O. U., I have placed the note here.—A. R. W.)

Beaverton. A. W. Anthony. "Common summer resident. First seen April 27; heard singing a few days later; bulk arrived by May 12." (L. B. P. D.)

- Camp Harney. Bendire. "Seen on but two occasions, in June, 1876." (L. B. P. D.)
 Salem. Wm. Warner.
 Portland. Ross Nicholas. 'Observed May 13 and 20, 1900.'
 H. T. Bohlman. Nesting June 27, 1894.
 Corvallis. A. R. W. Summer resident; not very common; first arrivals appear early in May.

Subgenus *Lanivireo*.

629a. *Vireo solitarius cassinii*. CASSIN'S VIREO.

- Dayton. Ellis F. Hadley. "Common summer resident; arrives April 15, leaves September 20; a few remain all winter and may be seen with bands of Chickadees and Bush-Tits; nests in May and June."
 Beaverton. . . . ; at Beaverton, Oregon, according to Mr. Anthony, on April 17, 1885, and became common on the 30th of April, a few breeding there." (L. B. P. D.)
 A. W. Anthony. "Very common at Beaverton, nesting in oaks and alders."
 Portland. H. T. Bohlman. 'Set of four May 6, 1900; incubation advanced. Set of five May 13, 1900; fresh.'
 Salem. Wm. Warner. "Summer resident and breeds here."
 Corvallis. A. R. W. Common summer resident. Recorded the first birds seen in both 1899 and 1900 on April 30.

Subgenus *Vireo*.

632. *Vireo huttoni*. HUTTON'S VIREO.

- Elkton. Fred H. Andrus. "Have recorded this species and collected a set of eggs but am now rather doubtful as to identity being correct."
 Salem. Wm. Warner. "Winter resident, always found with Ruby-crowned Kinglets and Oregon Chickadees."

632c. *Vireo huttoni obscurus*. ANTHONY'S VIREO.

- Beaverton. A. W. Anthony. "Seen but once, when the type was taken at Beaverton."
 Portland. A. W. Anthony. "February, 1901, Ross Nicholas shot one near the river below Portland."
 Corvallis. A. R. W. Have observed this species only in the latter part of March, in April, and in the first part of May. Uncommon. On May 5, 1900, met with a few adult birds and several young which were just able to fly.

Family *Mniotiltidae*. Wood Warblers. (Insectivorous and highly beneficial.)

Genus *Helminthophila*.

646. *Helminthophila celata*. ORANGE-CROWNED WARBLER.

- Camp Harney. Bendire. "Common during the migrations; a few remain to breed." (L. B. P. D.)

646a. *Helminthophila celata lutescens*. LUTESCENT WARBLER.

Yaquina Bay. Bernard J. Bretherton. "Abundant in spring and thought to breed here."

Portland. Ross Nicholas. "Numerous on May 20, 1900."

The Finley collection contains two sets of eggs taken on May 11, and one taken on June 3, 1895.

Dayton. Ellis F. Hadley. "Common summer resident; nests April and May."

Scio. Dr. A. G. Prill. "Summer resident; rare. One set of three."

Beaverton. A. W. Anthony. "First seen March 19, 1885; next seen March 31; April 10, common; breeds." (L. B. P. D.)

"Nests were found in the moss on the ground in vine maple and alder growths."

Salem. Wm. Warner. "Summer resident and breeds."

Corvallis. A. R. W. Summer resident; common, especially so during April and May. First arrive between the 23d and 29th of March.

Genus *Dendroica*.

Subgenus *Dendroica*.

652. *Dendroica aestiva*. YELLOW WARBLER.

Yaquina Bay. Bernard J. Bretherton. "Very numerous migrant."

Dayton. Ellis F. Hadley. "Common summer resident; arrives April 12. Nests in May and June."

Elkton. Fred H. Andrus. "Rare."

Beaverton. A. W. Anthony. "First, May 5, 1885; common May 22." (L. B. P. D.)

"Common summer resident, nesting in oak and alder growths."

Willamette Valley. O. B. Johnson. "A very common summer resident." (L. B. P. D.)

Camp Harney. Bendire. "A very common summer resident. It commences nesting about June 1." (L. B. P. D.)

Haines. Robert W. Haines. "First seen May 12, 1897, six birds; next seen May 14; common May 20. Abundant; breeds."

Salem. Wm. Warner. "Summer resident and breeds abundantly."

Portland. H. T. Bohlman. Nesting in June.

Ross Nicholas. "Numerous May 13 and 20, 1900."

Corvallis. A. R. W. Common summer resident from May 7 until the latter part of September. Nests throughout the latter part of May, June, and early part of July.

655. *Dendroica coronata*. MYRTLE WARBLER.

Yaquina Bay. Bernard J. Bretherton. "A rather rare migrant, as far as my observations go, but it may possibly breed here."

Willamette Valley. O. B. Johnson. "I have obtained several birds in spring that I have referred to this species." (L. B. P. D.)

Salem. Wm. Warner. "Spring migrant and breeds sparingly." Portland. H. T. Bohlman.

Corvallis. A. R. W. Not uncommon spring migrant. If present in the fall, I have at that season confounded it with *D. auduboni*.

656. *Dendroica auduboni*. AUDUBON'S WARBLER.

Yaquina Bay. Bernard J. Bretherton. "Very abundant in February and March and probably breeds here."

Elkton. Fred H. Andrus. "Migrant."

Portland. H. T. Bohlman. "First seen March 25; common April 15."

Ross Nicholas. "Numerous on the Willamette below Portland on February 27, 1900."

Beaverton. A. W. Anthony. "First seen March 22; rare until April 15; by April 21 the bulk had arrived. Most of them had gone April 25, though a few remained to breed. First seen March 9, 1885; next seen March 10; common March 28." (L. B. P. D.)

"Very common at Beaverton in small firs."

Willamette Valley. O. B. Johnson. "The most abundant warbler during summer, and a few remaining until far into, if not all winter." (L. B. P. D.)

Camp Harney. Bendire. "An abundant species during the spring migrations; arrives here about May 1. None seen in the fall. A few remain to breed in the Blue Mountains." (L. B. P. D.)

Salem. Wm. Warner. "Summer resident and breeds."

Corvallis. A. R. W. Resident; usually abundant during March, April and early May; not uncommon during winter months; common during latter part of September and whole of October; almost rare in summer. I have found nest and eggs on two occasions.

665. *Dendroica nigrescens*. BLACK-THROATED GRAY WARBLER.

Dayton. Ellis F. Hadley. "Not uncommon summer resident; arrives May 9, leaves October 2; nests in May and June."

Scio. Dr. A. G. Prill. "Summer resident; rare; one set of three."

Beaverton. A. W. Anthony. "May 10 1885, first; common May 24." (L. B. P. D.)

"Very common at Beaverton where it nests. I was unable to find nests, although the birds were seen with moss."

Willamette Valley. O. B. Johnson. "Moderately common during summer in favorable situations, seeming to prefer

dense undergrowth near a swamp. I took a nest of this species June 17, 1879, in the top of a clump of *Spirea*." (L. B. P. D.)
Canyon City. Bendire. "Observed on several occasions near the summit of the Canyon City Mountain during the early part of summer." (L. B. P. D.)

Portland. H. T. Bohlman. April 29.

Ross Nicholas. 'Abundant May 20, 1900.'

Salem. Wm. Warner. "Summer resident and breeds."

Corvallis. A. R. W. Summer resident from April 7 until the last of September. Not uncommon.

668. *Dendroica townsendi*. TOWNSEND'S WARBLER.

Yaquina Bay. Bernard J. Bretherton. "Not at all common but generally present in March and April."

Portland. H. T. Bohlman. April 25th.

Camp Harney. Bendire. "Rare; a specimen obtained May 11, 1875. I took a nest and three eggs which I believe belong to this species. They do not resemble any other warbler's eggs in my collection. The nest was placed in a narrow ravine amongst several small willow shoots near the main stem about four feet from the ground." (L. B. P. D.)

Beaverton. A. W. Anthony.

Corvallis. A. R. W. A single specimen taken during the spring migration of 1900.

669. *Dendroica occidentalis*. HERMIT WARBLER.

Dayton. Ellis F. Hadley. "Rare summer resident; nests in June."

Beaverton. A. W. Anthony. "Both (*D. townsendi* and *D. occidentalis*) are equally common, and in heavy second-growth fir are not at all rare; they no doubt nest high as no nests were found."

Genus *Geothlypis*.

Subgenus *Geothlypis*.

680. *Geothlypis macgillivrayi*. MACGILLIVRAY'S WARBLER.

Dayton. Ellis F. Hadley. "Common summer resident; arrives May 2; nests in May and June."

Sheridan. Arthur L. Pope. "Not uncommon in the mountains."

Elkton. Fred H. Andrus. "Common summer resident; breeds."

Willamette Valley. O. B. Johnson. "Summer resident, nesting quite commonly." (L. B. P. D.)

Beaverton. A. W. Anthony. "Common summer resident. First, May 18, 1885; common May 25." (L. B. P. D.)

"Quite common in Washington County, nesting in willow and hazel near the ground."

Camp Harney. Bendire. "Common summer resident. Arrives here about May 1. Nest and four eggs taken June 15." (L. B. P. D.)

Salem. Wm. Warner. "Summer resident and breeds here."

Portland. H. T. Bohlman. April 29.

Ross Nicholas. 'A pair on May 20, 1900.'

Corvallis. A. R. W. Common summer resident, appearing about the middle of April or a little later. My earliest record is of a specimen killed April 15, 1899.

681a. *Geothlypis trichas occidentalis*. WESTERN YELLOW-THROAT.

Dayton. Ellis F. Hadley. "Common summer resident; nests in May and June."

Sheridan. Arthur L. Pope. "Rare summer resident."

Beaverton. A. W. Anthony. "First, March 21, 1885; next seen April 1; common April 5." (L. B. P. D.)

Willamette Valley. O. B. Johnson. "Very common resident during summer." (L. B. P. D.)

Portland. H. T. Bohlman. "First seen April 26."

Salem. Wm. Warner. "Summer resident and breeds."

H. T. Bohlman. 'Set of four, fresh; near Salem, Oregon, May 25, 1897.'

Corvallis. A. R. W. Not uncommon summer resident from the middle of April until the last of September. Have found it nesting throughout the month of June.

Genus *Icteria*.

683a. *Icteria virens longicauda*. LONG-TAILED CHAT.

Dayton. Ellis F. Hadley. "Common summer resident; arrives May 4; nests in May and June."

Wilbur. W. E. Bryant. "Breeds." (L. B. P. D.)

Willamette Valley. O. B. Johnson. "During summer." (L. B. P. D.)

Camp Harney. Bendire. "Rare summer resident; arrives about May 15." (L. B. P. D.)

Salem. Wm. Warner. "Summer resident and breeds."

Beaverton. A. W. Anthony. 'Rare.'

Portland. Ross Nicholas. 'One on May 20, 1900.'

The Finley collection contains a set of four eggs taken at Milwaukie, a suburb of Portland, May 27, 1893.

Corvallis. A. R. W. Summer resident, appearing about or a little before the middle of May. In 1899, May 17; in 1900, May 12; not common.

Genus *Sylvania*.

685a. *Sylvania pusilla pileolata*. PILEOLATED WARBLER.

Yaquina Bay. Bernard J. Bretherton. "An abundant migrant in April."

Dayton. Ellis F. Hadley. "Common summer resident in the Coast Mountains of Yamhill and Tillamook Counties. Nests in May."

Beaverton. A. W. Anthony. "Common summer resident. First seen May 10, 1884; the bulk arrived May 20. First seen May 8, 1885." (L. B. P. D.)

Willamette Valley. O. B. Johnson. "Only noticed during spring migrations." (L. B. P. D.)

Salem. Wm. Warner. "Spring migrant; said to breed at the coast."

Portland. Ross Nicholas. "Specimen taken on Columbia River opposite Vancouver, Wash., May 13, 1900."

Corvallis. A. R. W. Spring migrant, appearing during the latter part of April and the first half of May. Not common.

Family Motacillidæ. Wagtails.

Genus *Anthus*.

697. *Anthus pensilvanicus*. AMERICAN PIPIT.

Yaquina Bay. Bernard J. Bretherton. "Very abundant in winter all along the coast."

Dayton. Ellis F. Hadley. "Common winter migrant."

Beaverton. A. W. Anthony. "It was first seen here April 17, 1885, large flocks; April 30 it was last seen." (L. B. P. D.)

Willamette Valley. O. B. Johnson. "Common during winter." (L. B. P. D.)

Camp Harney. Bendire. "Very abundant on the flats bordering Malheur Lake during the migrations, and in large flocks." (L. B. P. D.)

Salem. Wm. Warner. "Winter resident."

Corvallis. A. R. W. Abundant spring and fall migrant, appearing in the latter part of April in the spring, and in the fall in the latter portion of October and the first part of November. Observed a large flock December 16, 1901. Feeds on insects and small seeds.

Family Cinclidæ. Sippers.

Genus *Cinclus*.

701. *Cinclus mexicanus*. AMERICAN DIPPER.

Dayton. Ellis F. Hadley. "Common summer resident in the mountains. Nests in May."

Sheridan. Arthur L. Pope. "Common summer resident about the mountain streams."

Elkton. Fred H. Andrus. "Recorded at Loon Lake; breeds."

Willamette Valley. O. B. Johnson. "On all the dashing streams in the valley." (L. B. P. D.)

Applegate River. A. W. Anthony. "In March (about 10th to 15th, 1901,) I found this species very common along the Applegate River. They were in full song and were seen carrying nesting material."

Corvallis. A. R. W. Not uncommon along our mountain streams, where it feeds principally on small crustaceans; also on small fish and insects.

Family Troglodytidae. Wrens, Thrashers, etc.

Subfamily Miminæ. Thrashers.

Genus *Oroscoptes*.

702. *Oroscoptes montanus*. SAGE THRASHER.

Camp Harney. Bendire. "Common summer resident, one of the earliest birds to arrive in spring. It nests in various bushes, principally sage and serviceberry bushes. I believe that two broods are raised in a season. They leave here about the middle of September." (L. B. P. D.)

Baker City. A. W. Anthony. "The Sage Thrasher was found from Baker City east." (Letter, June 8, 1901.)

Subfamily Troglodytinæ. Wrens. (Insectivorous.)

Genus *Salpinctes*.

715. *Salpinctes obsoletus*. ROCK WREN.

Beaverton. A. W. Anthony. "May 21, 1885, one shot; the only one seen." (L. B. P. D.)

Camp Harney. Bendire. "Common summer resident; one of the earliest birds in spring and one of the latest in fall." (L. B. P. D.)

Haines. Robert W. Haines. "First seen May 14, common; abundant; breeds."

Genus *Catherpes*.

717a. *Catherpes mexicanus conspersus*. CANYON WREN.

Yaquina Bay. Bernard J. Bretherton. "Tolerably common resident."

Genus *Thryothorus*.

Subgenus *Thryomanes*.

719a. *Thryothorus bewickii spilurus*. VIGORS'S WREN.

Dayton. Ellis F. Hadley. "Common resident; nests in May."

Sheridan. Arthur L. Pope.

Elkton. Fred H. Andrus. "Summer resident; breeds."

Beaverton. A. W. Anthony. "Usually common; rare this year (1885)." (L. B. P. D.) 'Resident.'

Camp Harney. Bendire. "Rather rare in this vicinity." (L. B. P. D.)

Salem. Wm. Warner. "Summer and breeds."

Portland. Ross Nicholas. 'Numerous May 13, 1900.'

H. T. Bohlman. Nesting April 26 to June 10.

Corvallis. A. R. W. Resident; common in fall, winter and spring; uncommon in summer; breeds.

719— *Thryothorus bewickii calophorus*.

Yaquina Bay. Bernard J. Bretherton. "This newly separated subspecies is common here, in winter at least."

Genus Troglodytes.

Subgenus Troglodytes.

721a. *Troglodytes aedon parkmanii*. PARKMAN'S WREN.

Dayton. Ellis F. Hadley. "Common summer resident; arrives April 15. Nests, May and June."

Sheridan. Arthur L. Pope. "Common summer resident."

Scio. Dr. A. G. Prill. "Summer resident."

Elkton. Fred H. Andrus. "Common; breeds."

Beaverton. A. W. Anthony. "March 30, 1885, first seen; next seen April 1; common April 28." (L. B. P. D.)

Willamette Valley. O. B. Johnson, 1880. "Common during the summer." (L. B. P. D.)

Camp Harney. Bendire. "A very common summer resident, abundant wherever there is any timber. It commences nesting about June 1." (L. B. P. D.)

Salem. Wm. Warner. "Summer resident and breeds."

Portland. H. T. Bohlman. "Common; nesting."

Corvallis. A. R. W. Common summer resident arriving in the latter part of May. Nesting during June and possibly throughout July.

Subgenus Anorthura.

722a. *Troglodytes hiemalis pacificus*. WESTERN WINTER WREN.

Yaquina Bay. Bernard J. Bretherton. "Very abundant in December and January, and a resident but less numerous throughout the rest of the year."

Dayton. Ellis F. Hadley. "Common resident, more common in winter; nests in May and June."

Scio. Dr. A. G. Prill. "Constant resident; Two sets taken."

Elkton. Fred H. Andrus. "Resident; breeds; common in winter."

Willamette Valley. O. B. Johnson, 1880. "Remains during the winter, but leaves for other parts to breed." (L. B. P. D.)

Beaverton. A. W. Anthony. "Common winter resident." (L. B. P. D.)

Salem. Wm. Warner. "All the year."

Portland. H. T. Bohlman.

Ross Nicholas. Observed on Willamette River below Portland, February 27, 1900.

Fulton. The Finley collection contains a set of four eggs taken April 29, 1894, at Fulton, Oregon.

Corvallis. A. R. W. Resident; not uncommon from first of October until the middle of the following April; uncommon during summer.

Genus *Cistothorus*.Subgenus *Telmatodytes*.**725a. *Cistothorus palustris paludicola*. TULE WREN.**

Camp Harney. Bendire. "An abundant summer resident; a few winter here. In all marshy localities more or less abundant." (L. B. P. D.)

Beaverton. A. W. Anthony. "I saw a few at Wapato Lake in the fall of 1884."

Linkville. Wm. Warner. "Summer resident and breeds at Klamath Lake."

Corvallis. A. R. W. Have observed them during late fall and early winter and taken several specimens.

Family Certhiidae.

Genus *Certhia*.**726c. *Certhia familiaris occidentalis*. CALIFORNIAN CREEPER.**

Dayton. Ellis F. Hadley. "Not uncommon winter migrant."

Salem. Wm. Warner. "All the year in the mountains."

Beaverton. A. W. Anthony. "Not rare in Washington Co."

Portland. H. T. Bohlman.

Corvallis. A. R. W. Resident, frequenting principally fir timber; uncommon. Insectivorous.

Family Paridae. Nuthatches and Tits.

Subfamily Sittinae. Nuthatches. (Principally insectivorous; also feed on mast to some extent.)

Genus *Sitta*.**727a. *Sitta carolinensis aculeata*. SLENDER-BILLED NUTHATCH.**

Dayton. Ellis F. Hadley. "Not uncommon resident; nests in May."

Sheridan. Arthur L. Pope. "Tolerably common summer resident."

Willamette Valley. O. B. Johnson, 1880. "Quite common during the summer and not rare during the winter." (L. B. P. D.)

Beaverton. A. W. Anthony. 'Rather common but less so than the following.'

Portland. Ross Nicholas. 'Two seen on the Willamette below Portland, February 27, 1900.'

Camp Harney. Bendire. "Moderately abundant in the Blue Mountains and resident throughout the year." (L. B. P. D.)

Salem. Wm. Warner. "Summer resident and breeds."

Corvallis. A. R. W. Resident, not uncommon, found principally in oak timber.

728. *Sitta canadensis*. RED-BREASTED NUTHATCH.

Dayton. Ellis F. Hadley. "Common resident; nests in April and May."

Willamette Valley. O. B. Johnson, 1880. "Associated with *S. c. aculeata*." (L. B. P. D.)

Beaverton. A. W. Anthony. "Common in Washington Co."

Portland. H. T. Bohlman. February 21.

Salem. Wm. Warner. "All the year." Warner and Cooke's collection contained two sets of eggs taken in May.

Salem. H. T. Bohlman. Sets of six and another of seven eggs taken near Salem, Oregon, May 25, 1897.

Corvallis. A. R. W. Resident, not common. Found mostly in fir timber.

730. *Sitta pygmaea*. PYGMY NUTHATCH.

Camp Harney. Bendire. "A moderately abundant summer resident in the Blue Mountains. A few remain throughout the year." (L. B. P. D.)

Subfamily Parinæ. Titmice. (Insectivorous.)

Genus *Parus*.

Subgenus *Parus*.

735b. *Parus atricapillus occidentalis*. OREGON CHICKADEE.

Dayton. Ellis F. Hadley. "Common resident; nests in April and May."

Sheridan. Arthur L. Pope. "Common resident."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus. "Common resident; breeds."

Beaverton. A. W. Anthony. "Common resident." (L. B. P. D.)

Willamette Valley. O. B. Johnson, 1880. "Common throughout the year." (L. B. P. D.)

Wilbur. W. E. Bryant. "Specimens in the breeding season of 1883." (L. B. P. D.)

Camp Harney. Bendire. "Common during winter, retiring to the mountains to breed." (L. B. P. D.)

Salem. Wm. Warner. "All the year."

Portland. H. T. Bohlman.

Ross Nicholas. 'February 27 and May 13 and 20, 1900.'

Corvallis. A. R. W. Abundant resident, nesting in May and June.

738. *Parus gambeli*. MOUNTAIN CHICKADEE.

Camp Harney. Bendire. "Common during the winter in the willows and shrubbery. In the summer they breed on the higher mountains." (L. B. P. D.)

741. *Parus rufescens*. CHESTNUT-BACKED CHICKADEE.

Yaquina Bay. Bernard J. Bretherton. "Very numerous in winter and may be met with at all times of the year."

Dayton. Ellis F. Hadley. "Common resident; nests in April and May."

Sheridan. Arthur L. Pope. "Rare; sometimes seen in winter in company with *P. a. occidentalis*."

Willamette Valley. O. B. Johnson. "Less abundant than *P. occidentalis* which they closely resemble in habits." (L. B. P. D.)

Beaverton. A. W. Anthony. "Common resident; nest found April 28." (L. B. P. D.) "Less abundant in summer."

Salem. Wm. Warner. "All the year."

Portland. Ross Nicholas. "Numerous on the Willamette below Portland, February 27, 1900."

Corvallis. A. R. W. Not uncommon resident.

Subfamily Chamæinæ. Wren-Tits and Bush-Tits. (Insectivorous.)

Genus Chamæa.

742. Chamæa fasciata. WREN-TIT.

Yaquina Bay. Bernard J. Bretherton. "Common resident, most numerous in winter. This species is only met with on a strip of land lying directly along the ocean. Its range is inseparable from the Manzanita bush, and, as far as I know, Yaquina Bay is the limit of its northern range, and it is not found anywhere in our state east of the Coast Range."

Warner and Cooke's collection contained a specimen taken at Newport on Yaquina Bay, May 28, 1888. Mr. Warner says: "Found over at Newport; breeding, as plumage showed."

Genus Psaltriparus.

743. Psaltriparus minimus. BUSH-TIT.

Dayton. Ellis F. Hadley. "Common resident; nests in May and June."

Sheridan. Arthur L. Pope. "Common resident."

Elkton. Fred H. Andrus. "Common resident; breeds."

Beaverton. A. W. Anthony. "First seen March 11, 1885; March 12, tolerably common; breeds." (L. B. P. D.)

Willamette Valley. O. B. Johnson. "Plentiful during the winter months among the evergreens; always in small flocks. May remain all summer to breed, but they are more retired and less conspicuous." (1880.) (L. B. P. D.)

Salem. Wm. Warner. "Summer resident and breeds."

Portland. H. T. Bohlman. Nesting, May 23, 1893; May 10 and 11, 1895; April 29, 1897.

Corvallis. A. R. W. Resident, not common, nesting in latter part of April and whole of May.

743a. Psaltriparus minimus californicus. CALIFORNIA BUSH-TIT.

Yaquina Bay. Bernard J. Bretherton. "Very rare; only once met with in six years."

Scio. Dr. A. G. Prill. "Summer resident."

744. *Psaltriparus plumbeus*. LEAD-COLORED BUSH-TIT.

Camp Harney. Bendire. "A summer visitor, not abundant. I shot several specimens of this species in November, 1874. On June 6, 1876, I saw several near the summit of Canyon City Mountain, evidently breeding." (L. B. P. D.)

Family Sylviidæ. Warblers, Kinglets, Gnatcatchers. (Insectivorous.)

Subfamily Regulinae. Kinglets.

Genus *Regulus*.

748a. *Regulus satrapa olivaceus*. WESTERN GOLDEN-CROWNED KINGLET.

Yaquina Bay. Bernard J. Bretherton. "Common resident."

Dayton. Ellis F. Hadley. "Not uncommon in winter."

Sheridan. Arthur L. Pope. "Rare; sometimes seen in winter and fall."

Scio. Dr. A. G. Prill. "Constant resident."

Beaverton. A. W. Anthony. "Abundant when I arrived, February 2, 1884, decreasing in numbers soon after this time; last seen March 19. The species was last seen April 10, 1885; very rare this year." (L. B. P. D.)

Willamette Valley. O. B. Johnson. "Common throughout the winter in flocks." (L. B. P. D.)

Camp Harney. Bendire. "A few specimens November 7, 1875; not common." (L. B. P. D.)

Salem. Wm. Warner. "Winter resident."

Portland. H. T. Bohlman. January 25.

Ross Nicholas. Numerous on December 13, 1899.

Corvallis. A. R. W. Winter resident from the last of October until the middle of the following April. Not uncommon.

749. *Regulus calendula*. RUBY-CROWNED KINGLET.

Yaquina Bay. Bernard J. Bretherton. "Common resident."

Dayton. Ellis F. Hadley. "Not uncommon in winter."

Beaverton. A. W. Anthony. "First seen March 9, two birds; again seen March 12; last seen April 15. It was common during the migration." (L. B. P. D.)

Camp Harney. Bendire. "Undoubtedly breeds about here. A number remain amongst the willows and alders during the winter." (L. B. P. D.)

Salem. Wm. Warner. "Winter resident."

Portland. Ross Nicholas. Numerous on December 13, 1899; three on January 21, 1900; heard on May 20, 1900.

Corvallis. A. R. W. Resident; abundant from first of September until last of March. Not common during April, May and a portion of June. Almost rare during summer.

Family Turdidæ. Thrushes, Solitaires, Stonechats, Bluebirds, etc. (Insectivorous and Frugivorous.)

Subfamily Myadestinae. Solitaires.

Genus Myadestes.

754. *Myadestes townsendii*. TOWNSEND'S SOLITAIRE.

Yaquina Bay. Bernard J. Bretherton. "One specimen taken in September, 1900; no others seen."

Camp Harney. Bendire. "Rather common among the juniper groves during spring and fall and in mild winters throughout the whole season. None remain during the breeding season." (L. B. P. D.)

Salem. Wm. Warner. "In the valley only when it is very stormy; it undoubtedly breeds in the mountains as I have heard it at different times in the summer."

Portland. A. W. Anthony. "A specimen was several times seen in Portland last January (1901)."

Corvallis. A. R. W. Rare spring visitor.

Subfamily Turdinae. Thrushes.

Genus Turdus.

Subgenus *Hylocichla*.**758. *Turdus ustulatus*. RUSSET-BACKED THRUSH.**

Yaquina Bay. Bernard J. Bretherton. "A common resident seeking the seclusion of the dense forests in summer but more frequently met with in the open ground in winter."

Dayton. Ellis F. Hadley. "Abundant summer resident. Nests in June."

Portland. H. T. Bohlman. Nesting June 29, 1894, and June 20 and 21, 1895.

Sheridan. Arthur L. Pope. "Abundant summer resident."

Scio. Dr. A. G. Prill. "Summer resident."

Elkton. Fred H. Andrus. "Breeds; I think it is resident."

Beaverton. A. W. Anthony. "A common summer resident; breeds here." (L. B. P. D.)

Salem. Wm. Warner. "Summer resident and breeds."

Corvallis. A. R. W. Common summer resident from the last of April until the last of September.

759. *Turdus aonalaschkæ*. DWARF HERMIT THRUSH.

Dayton. Ellis F. Hadley. "Rare summer resident."

Beaverton. A. W. Anthony. "Common summer resident; first nest seen June 7, 1884." (L. B. P. D.)

Salem. Wm. Warner. "Spring migrant."

Corvallis. A. R. W. Rare migrant, late in both March and October.

759b. *Turdus aonalaschkæ pallasii*. HERMIT THRUSH.

Salem. Wm. Warner says that he has two specimens, taken on March 16 and April 28, 1891.

Genus *Merula*.

761a. *Merula migratoria propinqua*. WESTERN ROBIN. (Prof. F. E. L. Beal, in Farmers' Bulletin No. 54, U. S. Department of Agriculture, states that an examination of 330 stomachs of the Robin revealed 42 per cent of animal matter, principally noxious insects, and 58 per cent of vegetable matter, principally wild fruits, but 'little over 4 per cent being possibly cultivated varieties.' Considerable enmity is sometimes shown toward the Robin on account of its taste for cherries, but the small amount of these taken, in comparison with the great amount of insects, should prevail upon every farmer and orchardist to do all in his power to protect this useful species.)

Yaquina Bay. Bernard J. Bretherton. "Common resident all the year."

Dayton. Ellis F. Hadley. "Abundant resident; nests in April and May."

Sheridan. Arthur L. Pope. "Abundant resident."

Scio. Dr. A. G. Prill. "Constant resident."

Elkton. Fred H. Andrus. "Common resident; breeds."

Beaverton. A. W. Anthony. "A few were here when I arrived, February 2; about February 25 they began to arrive from the south and by March 12 were all here. First nest seen April 24 (1884.) One seen January 17, 1885; again January 21; common February 10; common in breeding season." (L. B. P. D.)

Cape Foulweather. S. L. Wass. "First seen February 22; next seen February 28, 1885; not absent more than two months, and some winters only during a cold wave." (L. B. P. D.)

Columbia River. Henshaw, 1879. "Robins were fairly numerous along the Columbia River during the last of October, and a few doubtless winter even at this high latitude." (L. B. P. D.)

Camp Harney. Bendire. "An abundant summer resident, breeding in great numbers in this vicinity. A few pass the mild winters here, frequenting at such times the junipers, whose berries furnish them their principal food. They are undoubtedly birds which have been reared farther north." (L. B. P. D.)

Portland. H. T. Bohlman. Set of four, fresh; May 27, 1898.

Haines. Robert W. Haines. "First seen February 29, one bird; common May 4, 1897; abundant; breeds."

Salem. Wm. Warner. "Resident all the year."

A. W. Anthony. "Common in all parts of the state visited."

Corvallis. A. R. W. Very common resident; nests during latter part of April and throughout May and June.

Genus *Hesperocichla*.**763. *Hesperocichla naevia*. VARIED THRUSH.**

- Dayton. Ellis F. Hadley. "Common winter resident; its nests and eggs have been taken in this county (Yamhill)."
 Sheridan. Arthur L. Pope. "Tolerably common winter resident."
 Scio. Dr. A. G. Prill. "Seen in winter only." "Nest and four eggs secured June, 1901."
 Elkton. Fred H. Andrus. "Winter resident; think this thrush breeds here in rare cases."
 Beaverton. A. W. Anthony. "Usually common in winter. March 16, 1885." (L. B. P. D.)
 Salem. Wm. Warner. "Winter resident."
 Newport, Oregon. Bernard J. Bretherton. "Common in January and February."
 Portland. H. T. Bohlman. January 10. April 15.
 Corvallis. A. R. W. A not uncommon winter resident in the valley from about the middle of October until the end of the following April, retiring to the timbered sections of mountains and foothills in summer.

Genus *Sialia*. (An examination of 205 stomachs of the eastern species (*Sialia sialis*), the result of which is recorded in Farmers' Bulletin No. 54, U. S. Department of Agriculture, "showed that 76 per cent of the food consists of insects and their allies, while the other 24 per cent is made up of various vegetable substances, found mostly in stomachs taken in winter." The vegetable food consists only of uncultivated species.)

767. *Sialia mexicana occidentalis*. WESTERN BLUEBIRD.

- Yaquina Bay. Bernard J. Bretherton. "Frequents the coast in winter but not met with during the summer months."
 Dayton. Ellis F. Hadley. "Common summer resident; a few remain all winter; nests in April and May."
 Sheridan. Arthur L. Pope. "Common resident."
 Scio. Dr. A. G. Prill. "Summer resident."
 Elkton. Fred H. Andrus. "Common resident; breeds."
 Camp Harney. Bendire. "Common during the migrations. None are known to remain and breed." (L. B. P. D.)
 Beaverton. A. W. Anthony. "Common summer resident; first seen February 29, 1884; March 15, abundant." (L. B. P. D.)
 Haines. Robert W. Haines. "First seen April 13, one bird; next seen April 20; common May 4; common, breeds."
 Salem. Wm. Warner. "All the year."
 Portland. Ross Nicholas. Three or four on Feb. 27, 1900.
 May 20, 1900, building.
 H. T. Bohlman. January 21, seen. Nesting June 1, 1894.

Corvallis. A. R. W. Common resident, even more plentiful during the two last winter months and in early spring. Nests in April and May.

768. *Sialia arctica*. MOUNTAIN BLUEBIRD.

Camp Harney. Bendire. "Breeds here but is not common. In the vicinity of Canyon City, Oregon, I found it rather abundant." (L. B. P. D.)

Sparta. A. W. Anthony. "The Mountain Bluebird was the only species that I found nesting at Sparta, thirty miles east of Baker City." (Letter of June 8, 1901.)



ADDENDA.

7. *Urinator imber* LOON.

Corvallis. A. R. W. A specimen November 23, 1901.

10. *Urinator pacificus*. PACIFIC LOON.

Corvallis. A. R. W. A specimen November 29, 1901.

215. *Prozana noveboracensis*. YELLOW RAIL.

Scio. Dr. A. G. Prill. "Female near Scio, Oregon, February 1, 1900. I have the specimen mounted and in my collection."

375a. *Bubo virginianus subarcticus*. WESTERN HORNED OWL.

Corvallis. A. R. W. A specimen on November 8, 1901.

529. *Spinus tristis*. AMERICAN GOLDFINCH.

Corvallis. A. R. W. A few specimens were also seen on several occasions during November and December, 1901, with flocks of *S. pinus*.

632c. *Vireo huttoni obscurus*. ANTHONY'S VIREO.

Corvallis. A. R. W. A specimen also seen on December 12, 1901.

BIRD LAWS OF OREGON.

Extracted from the Game Laws of the State of Oregon,
Compiled and Published by the Secretary of State, 1901.

Section 7. Ducks, Geese, Swan—

Except in the counties of Jackson, Klamath, and Lake, it shall be unlawful at any time between the first day of March and the first day of September of any year to take, kill, injure, destroy, or have in possession, sell, or offer for sale, barter or exchange any wild goose, wild swan, mallard duck, wood duck, widgeon, teal, spoonbill, gray, black, sprigtail or canvasback duck. In the counties of Jackson, Klamath, and Lake it shall be unlawful at any time between the first day of January and the fifteenth day of September of any year to take, kill, injure, destroy, or have in possession, sell or offer for sale, barter or exchange, any of the wild fowls or game birds mentioned in this section. And it shall be unlawful at any time for any person to kill or destroy any greater number than one hundred of the hereinbefore enumerated ducks in one week, or more than fifty in any one day. It shall be unlawful at any time to shoot at, or take, or kill, or attempt to take, kill, injure, or destroy by any means any wild goose, on any island or sand bar, in or along the Columbia River, and within this state east of the Cascade Mountains, on which wild geese habitually rest or roost; *provided however*, that in the County of Coos, the season during which it shall be lawful to take or kill the fowl mentioned in this section, shall be from the first day of August in each year to the first day of February in the following year, and it shall be unlawful in the said county of Coos to take, kill, injure, destroy, or have in possession, sell or offer for sale, barter or exchange, any of the said fowl between the first day of February and the first day of August in each year, and all the provisions of this section shall apply to the said County of Coos, except as to the time of the open season.

Section 8. Water-Rail and Upland Plover—

It shall be unlawful at any time between the first day of January and the first day of August of any year to take, kill, injure, destroy, or have in possession, or to sell, or offer for sale, barter or exchange, any water-rail or any upland plover.

Section 10. Sinkbox, Sinkboat, Sneakboat, Skiff or Other Boat—

It shall be unlawful at any time to use any sinkbox, sneakboat, skiff or other boat on the Columbia River or any of its tributaries

(except the Willamette and its tributaries above Oregon City) in the State of Oregon, for the purpose of shooting wild ducks, geese, swan or other water fowl therefrom. It shall be unlawful at any time to use any sinkbox, sinkboat or sneakboat on any waters of the State of Oregon for the purpose of shooting wild ducks, geese, swan or other water fowl therefrom.

Section 11. Batteries, Swivel Guns, etc.—

It shall be unlawful to use any battery, swivel or pivot gun, or other gun than one to be held in the hands and fired from the shoulder, either from the shore or on a boat, raft or other devise, on the Columbia River, or any lake or river in the State of Oregon, at any time for the purpose of shooting wild ducks, geese, swan or other water fowl.

Section 12 Fire Flashlight, etc.—

It shall be unlawful at any time between one hour after sunset and one-half hour before sunrise to fire off any gun, or build any fire, or flash any light, or burn any powder or other inflammable substance upon the margin or in the vicinity of or upon any lake, pond, slough or other feeding grounds frequented by wild ducks, geese, swan or other water fowl in the State of Oregon, with intent to shoot, kill or disturb any of such water fowl; *provided however*, that it shall be lawful to shoot ducks and geese in or upon grain fields at any time to prevent the destruction of grain or growing crops.

Section 13. Blinds, etc.—

It shall be unlawful for any person to build or use any blind or other structure in any public lake or river in the State of Oregon, or in the Columbia River, or in any lake in the State of Oregon which is not wholly owned by himself, his lessor or licensor, which stands more than one hundred (100) feet out from the shore or margin of such lake or river, for the purpose of shooting wild ducks, geese, swan or other water fowl therefrom at any time.

Section 14. Prairie Chicken, Grouse, Native Pheasant or Ruffed Grouse, Ring-Neck or China Torquatus Pheasant, Quail, Bobwhite Quail, and Partridge—Limit Ten Birds—

Except as provided in sections 15, 16, 17, 18, 19 and 20 of this act, it shall be unlawful at any time between the first day of December of each year and the first day of October of the following year, to hunt, pursue, take, kill, injure, destroy or have in possession, except for scientific and breeding purposes, or to sell or offer for sale, barter or exchange, any prairie chicken, grouse, native pheasant (sometimes called ruffed grouse), ring-neck or China torquatus pheasant, quail, bobwhite quail or partridge; and it shall be unlawful within the State of Oregon for any person to kill, capture or destroy any greater number than ten of the game birds enumerated in this sec-

tion in one day; *provided*, that in Douglas County prairie chicken, native pheasant, ring-neck or China torquatus, quail, bobwhite quail, and partridge (limit ten birds), except as provided in sections 15, 16, 17, 18, 19 and 20 of this act, it shall be unlawful at any time between the first of December of each year and the first day of September of the following year (grouse, ruffed grouse between the first day of December of each year and the first day of August of the following year) to hunt, pursue, take, kill, injure, destroy or have in possession, except for scientific or breeding purposes, or to sell or offer for sale, barter or exchange, any prairie chicken, native pheasant, ring-neck or China torquatus pheasant, quail, bobwhite quail, or partridge; and it shall be unlawful within the County of Douglas for any person to kill, capture or destroy any greater number than ten of the game birds enumerated in this section in one day.

Section 15. East of the Cascade Mountains (except County of Wasco), Pheasant, Quail—

It shall be unlawful at any time in that portion of the State of Oregon lying east of the Cascade Mountains, except in the County of Wasco, to hunt, pursue, take, kill, injure, destroy or have in possession, except for scientific or breeding purposes, or to sell or offer for sale, barter or exchange, any pheasant, except native pheasants (sometimes called ruffed grouse), or any quail, except bobwhite quails; or to hunt, pursue, take, kill, injure, destroy or have in possession, except for scientific or breeding purposes, or to sell or offer for sale, barter, or exchange, any sage hen, sage cock, grouse, or native pheasant (sometimes called ruffed grouse) at any time between the first day of November of each year and the first day of August of the following year.

Section 16. East of the Cascade Mountains (except the County of Wasco), Prairie Chicken—

It shall be unlawful in that portion of the State of Oregon lying east of the Cascade Mountains, except in the County of Wasco, to hunt, pursue, take, kill, injure, destroy or have in possession, except for scientific or breeding purposes, or to sell or offer for sale, barter or exchange, any prairie chicken at any time between the date of the passage of this act and the fifteenth day of August, 1903; and from and after said fifteenth day of August, 1903, it shall be unlawful in that portion of the State of Oregon lying east of the Cascade Mountains, except in the County of Wasco, to hunt, pursue, take, kill, injure, destroy or have in possession, except for scientific or breeding purposes, or to sell or offer for sale, barter or exchange, any prairie chicken at any time between the fifteenth day of November of each year and the fifteenth day of August of the following year.

Section 17. Bobwhite Quail—

It shall be unlawful in that portion of the State of Oregon lying east of the Cascade Mountains, except in Klamath and Lake counties,

to hunt, pursue, take, kill, injure, destroy or have in possession, except for scientific or breeding purposes, or to sell or offer for sale, barter or exchange, any bobwhite quail at any time between the date of the passage of this act and the fifteenth day of October, 1905; and from and after said fifteenth day of October, 1905, it shall be unlawful in said portion of the State of Oregon, to hunt, pursue, take, kill, injure or destroy, or to have in possession, except for scientific or breeding purposes, or to sell or offer for sale, barter or exchange, any bobwhite quail between the first day of December of each year and the fifteenth day of October of the following year.

Section 18. Wasco County—Prairie Chicken, Quail—

It shall be unlawful in the County of Wasco at any time between the fifteenth day of October of each year and the first day of August of the following year, or at any time when the ground is covered with snow sufficient for tracking, to hunt, pursue, take, kill, injure, destroy or have in possession, except for scientific or breeding purposes, or to sell or offer for sale, barter or exchange, any prairie chicken; or to hunt, pursue, take, kill, injure, destroy or have in possession, except for scientific or breeding purposes, or to sell or offer for sale, barter or exchange, any quail at any time between the fifteenth day of October of each year and the first day of August of the following year.

Section 19. Tillamook County—Ruffed Grouse, Ring-Neck or China Torquatus Pheasant, Blue Grouse—

It shall be unlawful in the County of Tillamook at any time between the date of the passage of this act and the fifteenth day of September, 1904, to hunt, pursue, kill, take, injure, destroy or have in possession, except for scientific or breeding purposes, or to sell or offer for sale, barter or exchange, any native pheasant (sometimes called ruffed grouse), or any ring-neck or China torquatus pheasant; and from and after said fifteenth day of September, 1904, it shall be unlawful in the County of Tillamook to hunt, pursue, take, kill, injure, destroy or have in possession, except for scientific or breeding purposes, or to sell, offer for sale, barter or exchange, any native pheasant (sometimes called ruffed grouse), or any ring-neck or China torquatus pheasant at any time between the first day of December of each year and the fifteenth day of September of the following year; and it shall be unlawful in the County of Tillamook to hunt, pursue, take, kill, injure, destroy or have in possession, except for scientific or breeding purposes, or to sell or offer for sale, barter or exchange, any blue grouse between the fifteenth day of October of each year and the first day of August of the following year.

Section 20. Counties of Josephine, Jackson, Coos, Curry, and Clatsop—Ring-Neck or China Torquatus Pheasant—Closed until 1904—

It shall be unlawful in the counties of Jackson, Josephine, Coos, Curry, and Clatsop, at any time between the date of the passage of

this act and the fifteenth day of September, 1904, to hunt, pursue, take, kill, injure, destroy or have in possession, except for scientific or breeding purposes, or to sell or offer for sale, barter or exchange, any ring-neck or China torquatus pheasant; and from and after said fifteenth day of September, 1904, it shall be unlawful in said counties at any time between the first day of December of each year and the fifteenth day of September of the following year to hunt, pursue, take, kill, injure, destroy or have in possession, except for scientific or breeding purposes, or to sell or offer for sale, barter or exchange, any ring-neck or China torquatus pheasant.

Section 22. English or Gray Partridge, Capercailzie, Moor Hen, Wild Turkey, Woodcock, Silver Pheasant, Golden Pheasant, Copper Pheasant, Green Japanese Pheasant, and Reeves Pheasant—Closed until 1905—

It shall be unlawful at any time between the date of the passage of this act and the first day of October, 1905, to hunt, pursue, take, kill, injure, destroy or have in possession, except for scientific or breeding purposes, or to sell or offer for sale, barter or exchange, any English or gray partridge, *capercailzie*, Moor hen, wild turkey, woodcock, silver pheasant, golden pheasant, copper pheasant, green Japanese pheasant or Reeves pheasant; and from and after said first of October, 1905, it shall be unlawful to hunt, pursue, take, kill, injure, destroy or have in possession, except for scientific or breeding purposes, or to sell or offer for sale, barter or exchange, any of the game birds enumerated in this section, between the first day of December of each year and the first day of October of the following year.

Section 23. Sale of Grouse, Pheasant and Quail—Allowed During Last Fifteen Days of Open Season—

It shall be unlawful within the State of Oregon to sell, exchange, or offer for sale or exchange, for money or other valuable consideration, or to take or kill for sale, or to have in possession for sale or exchange, except for scientific or breeding purposes, any pheasant, grouse or quail, at any time except during the last fifteen days of the open season for the killing of such grouse, pheasant or quail as hereinbefore provided in this act; *provided however*, that this section shall not be construed to in anywise change or alter any of the provisions of this act respecting said game birds; *provided further*, that every person, firm or corporation who shall, within the State of Oregon, purchase, or receive for the purpose of sale, or exchange or barter, or who shall sell or exchange or barter any grouse, pheasant or quail, shall keep a plain and true record, in book form, of every purchase or reception of any such game birds made by him, showing the date of purchase or receipt, and from whom purchased or received, and the number of birds of each kind purchased or received, and such record shall be open for inspection by the State Game and Forestry Warden, or any of his deputies, at all reason-

able times. Any person, firm or corporation who shall receive or purchase, and sell or exchange or barter, or offer for sale any of the game birds mentioned in this section without keeping such record as hereinbefore provided, or who shall fail or refuse to exhibit such record on demand at any reasonable time to the State Game and Forestry Warden, or any of his deputies, shall be guilty of a violation of this act, and upon conviction thereof shall be punished as hereinafter provided.

Section 24. Trapping, Netting, Ensnaring—

It shall be unlawful at any time to trap, net or ensnare, or attempt to trap, net or ensnare, any of the wild animals, wild fowl or game birds enumerated in this act.

Section 25. Robbing Nests, etc.—

It shall be unlawful at any time to willfully disturb or destroy the nest of, or to take or remove from any nest of any wild fowl or game birds enumerated in this act, any egg or eggs of such wild fowl or game bird, or to have in possession, sell or offer for sale or exchange, except for purposes of propagation or exhibition, any of such eggs or nests.

Section 26. Poison Wheat, etc.—

It shall be unlawful to place any poisoned wheat or other poisoned grain anywhere in the State of Oregon for the purpose of poisoning any of the wild fowl or game birds enumerated in this act.

Section 37. Construction of "Scientific Use" or "Scientific Purposes"—

Whenever the phrase "scientific use" or "scientific purpose" is mentioned in this act, the same shall be deemed to include only the examination and study of any bird or animal for the acquisition of knowledge thereof, and shall not include the taking of any bird or animal for mounting or preservation by taxidermy or otherwise for the purpose of sale, barter or exchange.

Section 39. Having in Possession—

It shall be unlawful at any time when it is unlawful to take or kill the same, to have in possession any of the wild animals, wild fowl or game birds enumerated in this act, unless the same be kept as a household pet, or for scientific or breeding purposes, or for purposes of exhibition in parks or in public museums; and proof of the possession of any of the aforesaid wild animals, wild fowl, or game birds at any time when it is unlawful to take or kill the same, unless they be kept as in this section provided, shall be *prima facie* evidence in any prosecution for a violation of the provisions of this act that the person or persons, firm, company or corporation in whose possession the same is found, took, killed, destroyed or had in possession the same in the county wherein the same is found during a period when it was unlawful to take, kill, destroy or have the

same in possession; *provided*, that it shall be lawful for any municipal corporation having a public park to have in its possession as an attraction in such park such of the aforesaid wild animals, wild fowl or game birds as may be desired by the authorities in charge of such park; and it shall be lawful for any private person to have and keep any of said wild animals, wild fowl or game birds as an attraction or adornment in any private park or grounds; and nothing in this section shall restrict the having in possession of natural history specimens in museums or scientific collections.

Section 43. Fines and Penalties—

Except as hereinafter provided, any person or persons violating any of the provisions of this act, or any other act or parts of acts for the protection of forests, wild animals, game, wild fowls, game birds, song birds, trout or other game fish not in conflict herewith, and for which no penalty is fixed, shall be deemed guilty of a misdemeanor, and, upon conviction thereof, shall be punished by a fine of not less than \$15 nor more than \$200, together with the costs of prosecution of said action, or by imprisonment in the county jail of the county wherein such offense may have been committed not less than seven nor more than one hundred days, or by both such fine and imprisonment.

Act of February 25, 1895.

Section 25—

Every person who shall, within the State of Oregon, after the passage of this act for any purpose injure, take, kill or destroy or have in his possession, except for breeding purposes, sell or offer for sale any nightingale, skylark, black thrush, gray singing thrush, linnet, goldfinch, greenfinch, chaffinch, bullfinch. red-breasted European robin, black starling, grossbeak, Oregon robin or meadow lark or mocking bird, shall be guilty of a misdemeanor.

Section 26—

Every person who shall, within the State of Oregon, at any time after the passage of this act, destroy or remove from the nest of any nightingale, skylark, black thrush, gray singing thrush, linnet, goldfinch, greenfinch, chaffinch, bullfinch, red-breasted European robin, black starling, grossbeak or mocking bird, any egg or eggs of such bird, or have in possession, sell or offer for sale any such egg or eggs, or willfully destroy the nests of any such birds, shall be guilty of a misdemeanor.

Section 27—

That every person who shall, within the State of Oregon, after the passage of this act, or any person willfully take, injure or destroy any seagull shall be guilty of a misdemeanor.

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- Page 5, Line 17, for parenthesis read parentheses.
" 6, " 7, supply quotation marks after year.
" 7, " 9-10, eliminate quotation marks.
" 8, " 40, for 30 read 30a.
" 16, " 16, for Surf Ducks read Surf-ducks.
" 20, " 23, for Arthus read Arthur.
" 22, " 37, for 272 read 272a.
" 28, " 10, for were read was.
" 32, " 40, for a set of three of the . . . read a set
of three in the . . .
" 33, " 31, for Rough Leg read Rough-leg.
" 34, " 18, for Breeds read breeds.
" 41, " 19, supply quotation marks after sunlight.
" 42, " 2-3, for a nest containing half-grown birds read a
nest containing half-grown young birds.
" 48, " 33, for 513a read 413a.
" 60, " 38, for Crovus read Corvus.
" 66, " 19, for Adundant read Abundant.
" 67, " 6, for Domesticus read domesticus.
" 72, " 5, for adundant read abundant.
" 72, " 17, for Yaquinna read Yaquina.
" 89, " 31, for Sippers read Dippers.

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CORVALLIS, OREGON.

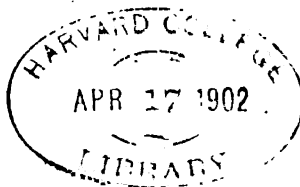
THE CODLING MOTH

AND

LATE SPRAYING IN OREGON

A. B. CORDLEY.

The Bulletins of this Station are sent Free to all Residents of Oregon who request them.



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View in College Orchard where most of the Experiments have been made.

The Codling Moth and Late Spraying in Oregon.



WONDERFUL stories of the codling moth are told "where rolls the Oregon." From the dealer in real estate and from the optomist who depicts the advantages of his particular region in the most glowing terms, comes the story of an apple grower's paradise where neither moth nor rust doth corrupt. From the horticulturist, who by the sweat of his brow has brought forth a bearing orchard only to see the golden and crimson fruits of his labor become the noisome habitations of disgusting caterpillars, comes lamentations like unto those of the prophet Joel: "That which the palmer-worm hath left hath the locust eaten; and that which the locust hath left hath the canker-worm eaten; and that which the canker-worm hath left hath the caterpillar eaten." Seen through the blue spectacles of his experience, nowhere else is the codling moth so destructive as in his own orchard or locality.

From the entomologist comes stories of the wonderful powers of reproduction exhibited by an insect, which, in other apple growing regions develops but one or two broods a year, yet, under the revivifying influence of an unknown something in our climatic, geographical or geological conditions, multiplies even unto the third and fourth generation in a single season.

Is it not possible that there is a happy middle ground of truth for all these stories? Is it not possible that we have all been mistaken? Is it not possible that even in the land of the real estate dealer and the optomist an occasional codling moth may be found? Is it not possible that other horticulturists in other regions have likewise had equal cause with us to echo the lamentations of Joel? Is it not possible that even the entomologist has been mistaken and that here as in less favored regions, the codling moth has refused to be stampeded by the wonderful prospects of new worlds to conquer and still goes on the even tenor of its way producing but two broods annually? Is it not time that we call a halt until the grounds on which these claims have been made can be thoroughly reconnoitered, that we may not be unduly elated by false hopes nor unduly discouraged by imaginary difficulties?

Are there Immune Regions?

It is undoubtedly true that there are small apple growing sections scattered here and there throughout the entire Pacific Northwest that are still free, or practically free, from the codling moth. But does this necessarily imply that they are to remain free? Does it necessarily imply that the climatic or other natural conditions are such that the moth cannot thrive there? May not the present immunity be accounted for on other grounds? During the past six years it has been my privilege to visit several of these favored sections and to note the conditions, both by observation and by conversation with resident fruit growers. Six or seven years ago Hood River, probably the most famous apple growing region in the state, was said to be practically free from this pest. Its presence in small numbers was admitted but little damage had been done and little fear was felt for the future. The cold evening breezes that come down from the mountains were said to prevent the moths from depositing their eggs. Today the mist from the spray pumps as it floats over the orchards of that region demonstrates alike the progressive nature of the fruit growers and the error of their former belief.

There are still scattered here and there throughout the eastern part of our state, communities that indulge in this same hope of immunity from the codling moth and for the same reason. It is seriously to be doubted whether their expectations have a firmer foundation of facts than existed at Hood River.

West of the Coast range of mountains there are other communities which also indulge in this same hope of immunity but for other reasons. There, it is not the cold breezes which come down from the mountains—the breezes do not come that way—but the moisture, the temperature, the “salt” or some other unknown feature of the ocean winds which kiss the orchards of those regions, that is supposed to carry death and destruction to the codling moth and joy to the hearts of the apple grower.

During the last few days of August and the first of September, 1899, I took a hurried trip through portions of Coos County, Oregon, for the special purpose of demonstrating, to my own satisfaction, the presence or absence of the codling moth and in case of its absence to investigate so far as the time at my command permitted, the conditions under which this immunity existed.

Leaving the railroad at Drain I went by wheel to Scottsburg, the head of navigation on the Umpqua, a distance of some twenty-five or thirty miles. Apple orchards along the route were visited and in every one the codling moth was present. One grower, within a few miles of Scottsburg, told me that it had been in his orchard about six or eight years. From Scottsburg to Gardiner, I went by boat and no orchards were visited. Indeed if any exist they are probably moth free since they are separated from each other by considerable distances and completely shut off from intercourse with the outside world except by boat. From Winchester, across the bay from Gardiner, to Coos Bay, the road leads along the beach and no orchards are present. In the immediate vicinity of Empire and Marshfield, the principal cities of the Coos Bay region, and the points at which the moth would the most likely be introduced in imported fruit, no orchards were seen. Across the bay from Marshfield I visited the orchards of Mr. Anton Wirth and Mr. McIntosh. In neither of these orchards was there to be found any evidence of the codling moth and Mr. Wirth informed me that it had never been seen there. The McIntosh orchard is an old one and showed evidence of neglect, conditions favorable to the development of the moth had it ever been introduced. Mr. Wirth, who has been a deputy fruit inspector of that region, did not know of any codling moth in that immediate vicinity but had heard that it is present in some orchards about the headwaters of Coos River, presumably along the Roseburg and Coos Bay stage route as that would correspond with the conditions I found on going out by way of the Myrtle Point-Roseburg route. From Marshfield to Myrtle Point, several orchards were noted along the line of the railroad but none were visited. At Myrtle Point I spent one day in examining orchards but found no wormy apples. Mr. T. F. Perkins, a nurseryman of Parkersburg, who has canvassed the county thoroughly each year, told me that the codling moth has appeared at a certain ranch on the Fishtrap between Coquille and Myrtle Point, in the North Carolina settlement on the headwaters of the South Fork and in an orchard on Big Creek near Bridge P. O. Mr. A. H. Black, a merchant who handles a large amount of fruit, reported that "wormy" apples are very scarce, but that a few had been found in the fruit from one orchard near Myrtle Point and one near Norway. One of these orchards was visited later but no codling moth could be found and the owner assured me that he had never seen a wormy apple in his

orchard. Near Big Creek, about ten or twelve miles out from Myrtle Point on the road to Roseburg, I was informed by two ladies that the codling moth had been present in the orchards of that vicinity for several years past. "In cutting up a pan of apples they usually found two or three wormy ones." No more orchards were seen until the home of Mr. L. B. Feller was reached, seven or eight miles farther out on the Roseburg road. Here I found the first codling moth larvæ I had seen on the entire trip, and was told by Mr. Feller that they had been present each season for the past three or four years. From Mr. Feller's place, a ride of some sixteen miles, during which no orchards were passed, took me to Camas. Here wormy apples were to be found in every orchard, a condition of affairs that proved to be true in the orchards between Camas and Roseburg.

As a result of this trip I became convinced that at that time (1900) the codling moth was not present, to any great extent at least, in the Coos Bay region. I also became convinced that the present immunity can be accounted for on the ground of isolation rather than that of peculiar climatic conditions, and that it is not likely to be permanent. Coos county is a beautiful region, broken, mountainous and timbered. Its only connection with the outside world is by boat, or by wagon roads over the mountains from Drain or Roseburg. The codling moth must of necessity be introduced by one or more of these routes. As shown above, the absence of orchards in the immediate vicinity of Empire and Marshfield, render it unlikely that the moth could obtain a foothold even though repeatedly introduced at these points in imported fruit. From Drain it has advanced from orchard to orchard nearly to tide-water at Scottsburg where it has been checked by the absence of other orchards to conquer. From Roseburg it has spread along the Roseburg-Myrtle Point route over the mountains to within ten or twelve miles of the latter place and is reported in several orchards about there. It is also reported in orchards about the headwaters of Coos river, having probably advanced from orchard to orchard along the wagon road from Roseburg to Coos Bay as it has along the Roseburg-Myrtle Point route.

It seems evident that the reason for the present immunity from codling moth ravages in the orchards of the Coos Bay region is not far to seek. On account of its geological conformation, the highways leading to this region mostly follow the windings of the streams

in and out among the timber-covered mountains. The orchards, mostly home orchards, are located here and there along the highways in little valleys or pockets between the mountains, often at considerable distances apart. Each orchard, or little group of orchards, is therefore protected by a natural barrier of timber and mountains, practically insurmountable to the codling moth unless it be carried over or around it by human agencies.

I believe the idea that climatic conditions are responsible for the absence of codling moth injury has been decidedly harmful. It has carried with it the idea that no effort is necessary to keep the orchards free from this, the greatest apple pest. I believe that by a rigid system of orchard inspection put in operation a few years ago along the highways leading from Roseburg to Myrtle Point and Coos Bay, and a rigid quarantine of infested fruit, that it would have been possible to exclude the codling moth from this entire region for years to come. It is probably too late now. Still there are undoubtedly many isolated orchards in which it is not yet found and which can be kept free from its ravages for years by a little effort. The utmost care should be taken to prevent its introduction into such orchards either in infested fruit or in the packages in which such fruit has been packed.

So far as the codling moth is concerned the Yaquina Bay region is essentially the same as the Coos Bay region. The codling moth has as yet caused no serious injury there; and the impression is quite generally held that conditions are such that it will not thrive. That it is present, however, is shown by the presence of wormy apples in the horticultural exhibit at the county fair held at Toledo in the fall of 1901. There as elsewhere in the state, where the pest has not as yet gained a firm foothold, it would seem far better for the fruit growers themselves to establish a strict orchard inspection and fruit quarantine in the attempt to check its spread rather than to rely on the vain hope that ocean breezes will compass its destruction. Other localities have been buoyed up with the same hope only to have it shattered with the passing of the years. In the Oregon Agriculturist and Rural Northwest, Jan. 15, 1899, occurs the following quotation from the Pajaronian of Watsonville, Calif.: "The codling moth has not been kept out, for any great length of time, of any of the districts where apples are produced for general sale. Every new apple district is 'without the codling moth territory.' We have talked that way about Pajaro valley; but the

codling moth has not kept away because of fogs or the fact that this district is within ten miles of the coast. * * * It will not be kept down by fogs and ten-miles-from-the-coast belts, alone. Active and intelligent work is necessary to check the ravages of this great apple pest, the most serious foe of Pajaro valley's greatest crop."

The mere fact that the codling moth is a serious pest in England, on the continent of Europe from Mediterranean regions to the northern limits of apple growing in Siberia, in southern Africa, Australia, New Zealand, Tasmania, China and most of the fruit growing regions of the United States and Canada, would indicate that the slight variation in climatic conditions which occurs between localities in this state in which the codling moth is a serious pest and those other localities only a few miles distant in which it is yet scarce or absent is not enough to account for its absence or scarcity.

Not More Destructive Here Than Elsewhere.

While I cannot, therefore, concur in the optimistic belief that any of the sections of the state devoted to apple growing are to remain permanently free from codling moth injury, neither can I agree with the pessimistic statement sometimes heard that such injury is much more serious here than elsewhere. Even approximately accurate estimates of the losses caused by any insect are difficult to make. In 1897, Mr. H. B. Miller, Ex-President of the State Board of Horticulture, stated that a very moderate estimate of the loss in that year from scale, moth and scab was one hundred and fifty thousand dollars. An editorial in the Oregon Agriculturist and Rural Northwest, Dec. 15, 1898, states that "The codling moth is about as interesting an insect to the freight managers of Oregon railways as to the fruit growers themselves. If it had not been for the ravages of that insect it is probable that the shipments of apples from the state this season would have been increased by at least a thousand carloads."

Simpson* states that 50 per cent of the apple crop of Idaho was destroyed by the codling moth in 1900, the injury ranging from 5 per cent in some well cared for orchards to 100 per cent in small orchards and isolated trees.

I have myself repeatedly observed individual trees, both in Oregon and Washington, on which it was practically impossible to find

* Bul. 30 New Series, Division of Entomology U. S. Department of Agriculture.

a wormless apple although the trees were loaded with fruit. I have not noticed, however, that the average annual loss is relatively greater here than in Michigan. I believe it is not.

Eighty years ago Kollar wrote that in Germany more than half, particularly of the choice fruit, was eaten into by the apple worm, and Stainton, a celebrated English entomologist, stated* that in 1868, in the vicinity of London it was scarcely possible to find a single fruit uninfested by the codling moth although there was an abundant apple crop. Recent reports seem to indicate that the injury is still as great in some parts of Europe as in America. During the past half century the losses in this country from the ravages of this pest have been enormous. Hardly a horticultural report from any apple growing region is to be found that does not mention its destructive work. In 1887, Forbes† made careful observations that led to the conclusion that the annual loss in Illinois from the codling moth is not less than \$2,375,000—one-half the value of the average apple crop of the state. In 1892, the loss in Nebraska is said to have reached at least \$2,000,000. Slingerland‡ estimates that in New York, with many growers employing modern methods of fighting the insect, the average loss is fully one-third of the total crop—a loss of \$2,500,000 worth of apples and \$500,000 worth of pears. He also states that “conservative estimates put the annual loss from its ravages, in all countries where it is noticeably destructive and but little is done to check it, at from 25 to 75 per cent of the crop of apples, but with pears the loss is considerably less.”

I do not intend to argue that the codling moth will become equally destructive in all localities or that the degree of its destructiveness is entirely independent of climatic conditions. It is known that the seriousness of its depredations varies both with the locality and with the season. It is admitted that “temperature is the great factor which controls the geographical distribution of life, and temperature is at the back of all those apparent living first causes which control the abundance of a species in a given region, provided we trace them far enough.” I do wish to suggest, however, that in the case of an insect that has exhibited such a wide range of adaptability to varied climatic conditions as has the codling moth, that it is not likely that anywhere within the limits of this state are

* See Am. Ent. Vol. 1. 1869.

† Bul. 1, State Ent. of Ill.

‡ Bul. 142, Cornell Univ. Expt. Sta. The best account of the insect ever published.

these conditions to be relied upon to prevent its development in injurious numbers.

I believe that neither actual nor prospective fruit growers should allow themselves to be in the least discouraged by reports of the unusual destructiveness of this insect in the Pacific Northwest. Its ravages are serious to be sure, but so they are in other apple growing centers. No doubt there are localities in which the codling moth has been present but a comparatively short time, where the injury has been excessive during one or perhaps several years. The balance of nature has not been struck. The various enemies of the moth are not yet doing their share in reducing its numbers. Such conditions have occurred and do still occur elsewhere, seasons of excessive loss alternating with seasons of comparatively little injury. I believe a candid examination of the facts should give hope for the future.

Number of Broods in Oregon.

I feel somewhat more diffident about touching upon the story told by entomologists regarding the number of annual broods of the codling moth in the Pacific Northwest. Observations for the past six years have led me to a different conclusion than that arrived at by my associates. Washburn* states that there are at least four broods in Oregon. Aldrich† reports three broods in the section from Boise to Weiser and about Lewiston and part of a fourth about Boise. Simpson‡ states that there are three broods about Boise and the greater part of the Snake River valley. Parts of eastern Oregon are similar to the sections of Idaho mentioned, and should the conclusions of Aldrich and Simpson prove to be correct, three broods may likewise be expected in the eastern part of the state.

However, I have been entirely unable to find any evidence to support Washburn's conclusions and I believe the others, likewise, will eventually prove erroneous. In every instance, so far as I have been able to determine, statements regarding third and fourth broods are based on inferences and not on actual breeding records. Washburn, judging from his published account, determined the length of time required for the development of the first brood. Having done this by a process of simple division, he showed "how easily four broods can appear during our long warm seasons."

*Bul. 25, Or. Expt. Sta.

†Bul. 21, Idaho Expt. Sta.

‡Bul. 30, New Series, Div. Ent. U. S. Dept. Agr.

To make his ideas more easily understood he embodied them in the following table:*

	A	B	C	D	E
Moths emerge from cocoons	June 1	June 20	Aug. 9	Aug. 28	Oct. 17
Egg laying (when moths are about 10 days old).....	June 11	June 30	Aug. 19	Sept. 7	Oct. 27
Hatching of eggs (5-10 days)	June 21	July 10	Aug. 29	Sept. 17	Nov. 6
Life of larvæ in apple (4 weeks).....	July 19	Aug. 7	Sept. 26	Oct. 15	Dec. 4
End of larval and pupal stages in cocoon (3 weeks) and emergence of moths.....	Aug. 9	Aug. 28	Oct. 17	Nov. 5 or following spring	Emerging following spring

Columns A, C and E are supposed to represent the broods which might develop from moths that were assumed to have emerged June 1 and deposited eggs June 10. Columns B and D represent the broods that should develop from moths that emerged June 20 and deposited eggs June 30. So far as the latter columns are concerned it may be assumed that they are approximately correct except for the implied inference that at least a partial brood of moths would appear Nov. 5. The data furnished do not support the conclusion he draws from columns A, C and E that "the moth is at least four brooded in Oregon." Moths are assumed to emerge June 1 and deposit eggs June 11, but on the same page the statement is made that eggs were found (June 28) long before any wormy apples were found." Further, according to his calculations the moths that are to deposit eggs for the third brood of larvæ should issue about the middle of October. There is no evidence, however, that he ever bred any moths at this time, or even attempted to. I have made the attempt and have as repeatedly failed. The first brood runs through very nicely at Corvallis on Washburn's schedule B and the second brood follows it very well until the larvæ are fully grown and have left the apples and spun up in their cocoons, but there they remain. Instead of transforming to moths that should deposit eggs for a third brood of larvæ they persist in remaining as larvæ until the following spring. In other words, instead of four estimated broods I find only two actual broods.

I cannot be so certain regarding the number in eastern Oregon. The Willamette Valley lies wholly within the Transistional faunal zone. Parts of eastern Oregon, Washington and Idaho lie in the Up-

*See Bul. 25, Or. Exp. Sta.

per Austral. It is possible that there as well as in southern Oregon an additional brood may develop. So far as I can determine from published accounts, however, the development of a third brood has never been proved—it is inferred from the presence of numerous larvæ in fruit late in the fall and from band records both of which may be misleading. Thus Forbes* was lead to suspect the presence of a third brood in southern Illinois in 1886 from the unusual abundance of larvæ late in fall, but Le Baron† had *bred* but two broods at Chicago and Riley‡ had invariably found it double brooded at St. Louis. A third brood has been reported in Kansas and in Nebraska and Gillette was for a time under the impression that it also developed in Colorado, parts of which, together with Kansas and Nebraska, lie in the Upper Austral zone, but in a recent letter he writes me that there is not the least evidence of even a partial third brood any where in the state. In California, Coquillett's§ notes indicate that it is three brooded, but Koebele|| reports it as two brooded as a rule in the Santa Cruz Mountains and that it will not differ in its habits to any extent throughout California. Washburn's statement regarding the third and fourth broods at Corvallis is without any foundation of facts; while those of Aldrich and Simpson for Idaho seem to be based principally on band records which may be misleading from the fact that the relative number of larvæ found under the bands at different times may depend upon whether the evening temperature some four or five weeks previously to the time the record was taken was favorable or not for active egg laying by the moths, as well as upon the appearance of another brood of moths. Cockerell§§ alone seems to have established pretty conclusively the presence of a third brood in parts of New Mexico, but since the moths of this brood began to appear as early as August 21, it is possible that a wrong interpretation has been placed upon the observed facts. So far as the evidence available at present can be relied upon it would seem that the burden of proof still lies with those who maintain the existence of a third brood. One and two broods have been repeatedly bred in various parts of the world. A third or fourth never has been bred, and I believe it is at least doubtful whether it ever develops. If the number of

* Fifteenth Rept. State Entomologist. (1885-1886).

† Third Rept. on Insects, III.

‡ Am. Entomologist, Vol. 11. (1870).

§ Bul. 30, Div. Ent. U. S. Dept. Agri.

|| Bul. 22, Div. Ent. U. S. Dept. Agri.

§§ Bul. 25, N. Mex. Sta.

broods is governed at all by faunal zones it would seem from the evidence that one brood only is to be expected in the Boreal zone, a partial or complete second brood in the Transition zone and a complete second with a bare possibility of a third brood in the Upper Austral.

Whether or not a third brood ever develops is of very little practical importance to fruit growers. Owing to irregularity of development, the different broods so overlap that the insect can be found in all stages during most of the time from July 1 to Sept. 15. The facts remain that throughout this western country the larvæ are very abundant late in the season and cause far more loss than all other apple pests combined. There is thus a constant demand from apple growers for information as to the habits of the insect, and the best methods of reducing its ravages. It is the purpose of this bulletin to supply this information and at the same time to record my own observations and experiments.

Description and Life History.

When fully grown in fall, each larvæ usually leaves the fruit in which it developed, seeks some secluded spot and spins about itself a silken cocoon in which it passes the winter. Late in March, some of these larvæ transform to pupæ from which the moths emerge about the first of April, and from this date moths are continually emerging until the first part of July.

The accompanying illustrations show the size and general characteristics of the moths. They are really beautiful little creatures. The abdomen and the hind wings, which are covered when the insect is at rest, are of a modest greyish brown color. The ground color of the fore wings is similar, but is relieved by transverse, wavy, alternating bands of grey and brown. Perhaps the most characteristic marking is a large golden-bronze spot at the inner hind angle of each front wing. I know of no other common insect with this mark and no insect in which it is absent need be mistaken for the codling moth. The males are further distinguished by a narrow pencil of black hairs on the upper surface of the hind wing and an elongated blackish spot on the under surface of each front wing. Owing to its peculiar coloring which harmonizes well with the color of the bark, and the habit of usually remaining quiet during the daytime, it is rare indeed to find a fruit grower who is acquainted with this beautiful but destructive little insect. Indeed,

I find that commonly the most widely divergent ideas are held as to its appearance, and unscrupulous persons, rely upon this widespread ignorance to advertise and sell "trap lanterns" and other worthless devices for capturing the moths. Only a slight knowledge of the appearance of the moth is needed to convince even the most credulous that the masses of insects caught by such means rarely contain a codling moth. Such a knowledge can readily be obtained by picking some wormy apples in July or August and placing them in some closed receptacle. In the course of a few weeks the moths will emerge. When once familiar with their appearance one may detect them flitting about the trees at dark depositing their eggs upon the fruit, and more rarely upon the foliage, and may occasionally observe them during the daytime resting quietly upon the leaves or bark. I have also rarely found them resting upon the ground.

It is usually stated that the moths appear in spring about the time the apple trees are in bloom. Slingerland* sums up his own observations as well as those previously published by other observers with the statement that "what little definite evidence there is upon this point indicates that the majority of the moths do not emerge until several days after the petals have fallen."

At Corvallis there seems to be no relation, whatever, between the time at which the apple trees are in bloom and the dates on which the moths emerge. In 1896, apple trees were in full bloom April 20 and most of the petals had fallen by May 1. Only a few moths were reared that season but some of these emerged as late as the middle of June. In 1898, the trees were beginning to blossom April 10 and the blossoms had mostly fallen by April 28. In a store-room moths began to appear as early as April 10 and on June 16 two perfectly fresh specimens were captured in the orchard. In 1899, moths began to appear in breeding cages April 10 and continued to emerge to July 1. April 21, the earliest apple trees were just coming into blossom and the petals were not all off before May 10. Although the apple trees were in blossom nearly two weeks later in 1899 than in 1898, the moths began to appear at practically the same time (April 10-11) and continued to emerge for nearly or quite two months after the blossoms had fallen.

A still more remarkable variation from the usual habits of the insect as recorded from other localities, exists in the times at which

*Bul. 142, Cornell Univ. Expt. Sta.

the moths deposit their eggs. The idea held until recently was that the eggs are laid in the calyx or blossom end of the fruit soon after the blossoms fall. This idea was first shown to be erroneous by the observations of Koebele in 1888.* In September he found only about one pear in twenty without eggs or young larvæ of the codling moth. "As many as eleven eggs were found upon a single pear. One was found on the stem, six on the pear surrounding the stem, two on the upper half and the other two near the calyx." Since then the fact that the eggs are not laid in the calyx but upon the exposed surface of the fruit, has been verified by Washburn, Slingerland, Card and others, and Card has also called attention to the fact that they are sometimes deposited upon the leaves.

In New York, Slingerland found eggs upon the fruit the last week in May (1896-97), a week or more after the blossoms had fallen. Gillette states that in Iowa in 1889 no larvæ had hatched until nearly a month after the blossoms were off. Allowing for an existence of a week or ten days for the egg stage would bring the date of oviposition from two to three weeks after the petals fell. In 1887, Card observed that while the petals were mostly off by May 10, the first eggs were not found until about three weeks later.

At Corvallis egg laying is delayed until a much later date. April 10, 11 and 12, 1898, moths were placed in breeding cages with fresh blossoms for the purpose of obtaining eggs. None were obtained, however, and neither eggs nor larvæ were seen upon fruit out of doors until July 1, when a single recently hatched larvæ was found just beneath the skin of a Waxen apple. July 4, three more were found, and on July 7, 97 of the 475 apples on the tree were found to contain young larvæ. Allowing a maximum of ten days for the egg stage brings the date at which the very first eggs were deposited at June 21, while egg laying evidently did not become general until about June 28. As shown above the petals had fallen by April 28, about two months before. In 1899, however, moths were placed in breeding cages with fresh blossoms on April 21, 22, 25, 29, May 4, 5, 8, 9; and on May 11, ten eggs were deposited. At this time the petals had been off the trees scarcely more than two weeks. However, no eggs or larvæ were obtained on fruit on the trees until June 28 when numerous eggs and very young larvæ were found on Ben Davis apples. In 1900 the blossoms were mostly off by May 1. The first egg was seen June 11, another June 14 and the

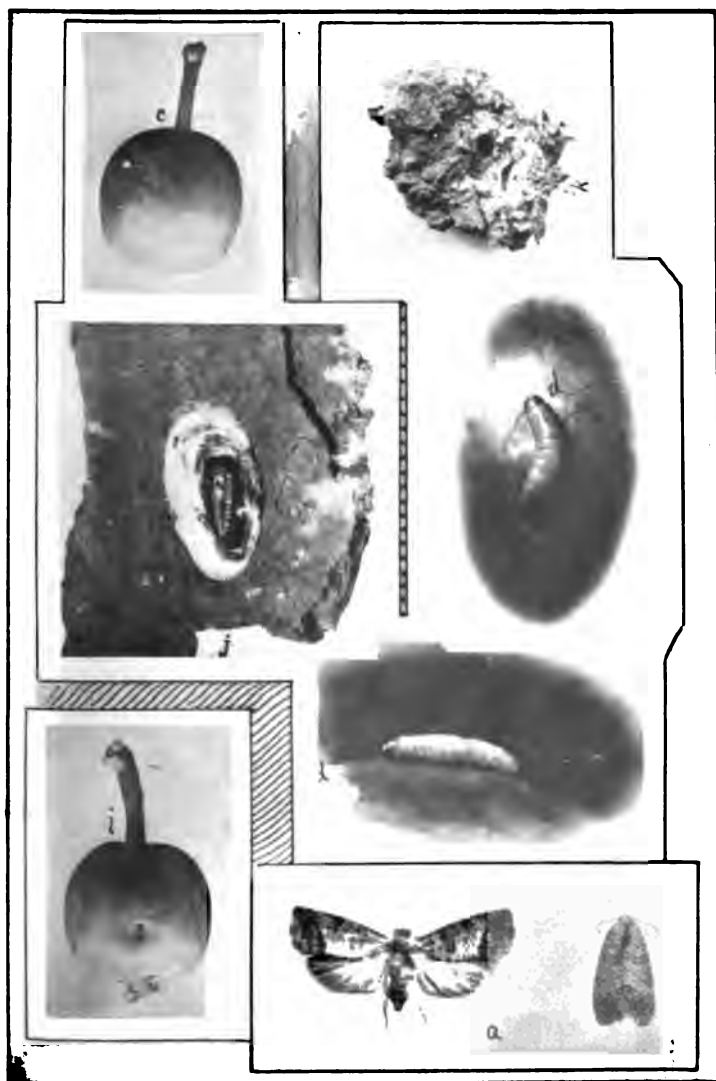
*Bul. 22. Div. Ent. U. S. Dept. Agr. (1890).

first larvæ June 26. It appears from the above observations that while the blossoms fell at various dates from April 28 to May 10, egg laying rarely begins before the middle of June and is not general, much if any before June 25. This does not hold true for the dryer and warmer parts of the state, nor is it necessarily true for the entire Willamette Valley. In Southern Oregon and parts of Eastern Oregon egg laying certainly begins in May, and reports from various parts of the Willamette Valley indicate that the date at which the first larvæ begin to work in fruit at Corvallis is unusually late even for this section.

Effect of Evening Temperature on Habits.

I have been somewhat at a loss for a satisfactory explanation of this variation from the normal habits of the insect. Knowing that the moths are most active just at dusk, I have attempted to account for it on the ground that our evenings are unusually cool throughout May and the greater part of June. Corvallis lies directly opposite a gap in the Coast range of mountains which may account for the fact that it is daily blessed with a cool sea breeze which rapidly lowers the temperature after three or four o'clock in the afternoon. It is possible that this low temperature may account for the delayed oviposition. To bring out this point more clearly I have compiled the following table showing the daily temperature at 8 P. M. from May 1 to October 1, practically the entire period during which moths are on the wing here, for the years 1898, 1899, 1900 and 1901. The record for May and September, 1898, was not available.

Records of this character for only four years, and for one locality only, do not prove anything. They may, however, be suggestive. In this instance, if they show anything, it is that the moths do not deposit eggs when the evening temperature falls much, if any, below 60°, and that as the temperature raises above that point the activity of the moths increase. I have never seen eggs of the codling moth out of doors here in May. A glance at the table will show that very rarely indeed does the evening temperature reach 60° during that month. The average for the month is only 53°. Egg laying, as shown above, ordinarily begins about the middle of June and becomes general towards the close. The average evening temperature for June is just 60°, and rarely does it go above 65°. It is also continued during the first part of July but since the emergence of but few moths of the first brood is delayed until the latter part



THE CODLING MOTH. (Original.)

THE CODLING MOTH.

Fig. a. The moth with wings folded and with wings expanded. Enlarged $1\frac{1}{2}$ dia.

Fig. c. The white spot on the apple is intended to represent the position and size of an egg.

Figs. d.d. The full grown larva resting on the surface of an apple. Dorsal and lateral views. Both natural size.

Fig. i. Shows point of entrance of larva at side of growing apple. Somewhat reduced.

Fig. j. A cocoon on the under surface of a piece of apple bark. Cocoon has been torn open to show inclosed pupa. Enlarged $1\frac{1}{2}$ dia.

Fig. k. A clod of soil containing a pupa of the codling moth. Position of pupa indicated by x. Reduced one-half.

of July, and but few of the second brood emerge so soon, the temperature of the latter part of July need not be considered. A very large proportion of the total injury done by the moth in the state occurs during August and the first part of September, when the average evening temperature is highest. During this time a considerable number of evenings occur with a temperature of 70°-85°.

Table Showing Daily Temperature at 8 P. M. from May 1 to October 1 for the Years 1898, 1899, 1900 and 1901.

DATE.	1898					1899					1900					1901				
	Tem. May	Tem. June	Tem. July	Tem. Aug.	Tem. Sept.	Tem. May	Tem. June	Tem. July	Tem. Aug.	Tem. Sept.	Tem. May	Tem. June	Tem. July	Tem. Aug.	Tem. Sept.	Tem. May	Tem. June	Tem. July	Tem. Aug.	Tem. Sept.
1		66	64			43	50	67	67	63	60	59	63	64	59	50	57	53	70	60
2		65	66			48	58	65	73	59	64	65	61	67	68	48	65	53	70	63
3		62	69			53	52	52	75	58	69	61	61	65	54	51	52	57	80	62
4		59	79			50	53	50	74	55	58	67	62	62	60	51	55	64	85	59
5		67	67			47	47	54	71	57	55	58	65	63	66	54	56	63	82	55
6		71	68	61		54	53	53	70	54	54	72	67	57	64	55	53	62	78	56
7		71	65	63		60	60	52	63	62	60	71	70	59	57	55	52	55	69	61
8		73	60	64		52	67	55	61	66	62	63	73	53	62	56	53	63	69	60
9		69	65	75		55	67	55	62	67	59	76	73	62		57	56	64	71	70
10		55	68	64		56	60	54	66	71	56	68	60	59		66	60	63	73	61
11		59	60	64		48	52	60	70	63	52	75	52	61		64	55	61	74	63
12		60	60	71		49	53	60	62	58	53	72	58	60	60	56	58	60	76	62
13		57	60	70		45	60	64	55	55	59	63	58	82	55	58	52	80	77	61
14		59	70	71		51	63	64	59	54	62	58	60	81	54	55	62	67	86	70
15		58	61	69		46	70	61	61	59	55	60	53	73	54	58	65	64	68	78
16		62	61	67		47	71	71	59	60	53	61	61	74	55	55	71	61	71	77
17		67	65	63		46	70	73	66	57	58	61	63	75	55	49	72	63	65	80
18		58	60	63		47	75	73	60		56	66	76	76	59	50	59	60	59	59
19		55	57	62		48	56	69	61		59	69	76	80	61	48	61	62	62	58
20		52	49	64		50	55	65	54		62	63	72	57	62	58	58	65	62	54
21		50	57	61		56	67	62	56		58	61	65	69	56	55	55	67	70	56
22		50	51	68		52	67	67	60		56	67	60	69	51	54	51	68	70	54
23		60	55	78		54	60	80	66		52	67	62	64	55	55	51	64	61	53
24		52	56	63		50	58	70	61		58	60	63	68	54	70	54	65	65	56
25		54	74	59		52	56	75	60	71	48	62	64	65	55	74	55	65	59	58
26		54	78	61		52	54	73	55	69	54	72	62	66	60	59	58	65	65	56
27		87	61			50	58	70	62	64	51	60	72	60	55	58	60	66	68	54
28		85	69			52	58	60	62	59	55	61	75	64	53	56	66	69	69	61
29		64	85	59		48	57	62	66	59	63	58	80	60	49	54	54	65	71	63
30		55	80	55		52	57	60	74	55	62	62	82	65	52	62	60	62	61	56
31		60	80	53		56		62	59		57		83	60		67		70	63	
Ave.	59+	65+	66			50+	59+	63+	64-	61-	54+	64+	66	66-	57+	56+	57+	60-	70-	61

The Egg.

The eggs of the codling moth are minute scale-like objects about one-twentieth of an inch in diameter. They may be likened to a very small trout scale glued to the surface of the leaf or fruit. Being so small and at the same time transparent, or with only a slight yellowish tinge, they can be detected only with difficulty by those unfamiliar with their appearance. When once familiar with them, however, and every apple grower should become familiar with them,

one can readily find them in this vicinity at any time from late in June until at least Oct. 1, and probably later. So far as my observations go, they are found much more commonly upon the fruit than upon the leaves, although undoubtedly when fruit is scarce they may be more abundant upon the leaves. The white spot on the apple, c, in the illustration is to represent the size and position of an egg.

The duration of the egg stage probably depends somewhat upon temperature. According to recorded observations, it may range from four to ten days. A large number of eggs were deposited in one of my breeding cages, Sept. 5, 1898. Sept. 10, the developing larvæ could be plainly seen through the shells and most of them emerged Sept. 12, seven days after the eggs were deposited. This corresponds with Slingerland's observations in New York and is undoubtedly, as he suggests, about the average duration of this stage. Several of the larvæ were seen to emerge from the egg. In every instance they broke through the upper shell and entered the fruit at some other point. Simpson, however, mentions instances in which the larvæ had evidently eaten directly through the lower surface of the shell into the fruit. If such a habit were general our poison sprays would, of course, be valueless.

The Larvæ.

When first hatched the young larvæ are scarcely more than one-sixteenth inch long, semi-transparent or whitish in color and marked with little black spots each of which bears a minute hair. The head, and the thoracic and anal shields are black.

True to the instinct of self preservation, the young larvæ attempt to get under some protecting cover as soon as possible. Crawling here and there over the surface of the fruit, they seek some secluded spot where they may be hidden from their numerous enemies. This undoubtedly accounts for the fact that a large proportion of them enter the fruit at the blossom end, at the point of contact of two apples, or where a leaf rests upon a fruit. Failing to find such a sheltered spot, the young larva spins a web of a few silken threads on the surface of the fruit, evidently to give a firmer foot-hold, and immediately attempts to bite through the skin. One that I observed succeeded only after several ineffectual attempts, and while making these attempts and in burrowing into the fruit, as much haste was exhibited as a soldier under fire would probably exhibit in con-

structing a rifle pit. In a little more than an hour it had excavated more than its full length into the fruit, enlarged the cavity so that it could turn about in it and spun a silken protecting web across the entrance. The reason is evident why the codling moth in its larval stage within the fruit is subject to the attacks of so few enemies.

Once beneath the skin or within the protecting folds of the calyx, the young larva may feed for several days near the surface, or it may proceed at once towards its objective point, the core, where it feeds upon the seeds and excavates irregular cavities which are filled with masses of filthy droppings matted together with silken threads. (See Fig. g). Its presence in the fruit can soon be detected by the presence of the familiar frass which is crowded from the burrow and remains matted about the entrance probably as a further barrier to the entrance of enemies. See Figs e and i. As it increases in size, the head and the thoracic and anal shields turn from black to brown and the body acquires a pinkish tinge. See Figs. d. d. Some days before it stops feeding the larva eats an exit passage to the surface of the fruit but takes the precaution to close the opening with a protecting pellet of frass and silken threads. When full grown it pushes this pellet aside and leaves the fruit.

The length of time required for the larvæ of the first brood to become full grown varies greatly. Some accounts give a period of only 10-14 days; others as much as thirty three-days. As stated above, in 1898, the first larvæ was found in fruit July 1, and not until July 7 could any considerable number be found. The latter were very small, certainly not over four or five days old. They were placed in breeding cages and July 19, the first one left the fruit and began to spin its cocoon. The others continued to emerge until July 26. This gives in this particular instance a larval period in the fruit of 16-24 days.

The Pupa.

The summer and most fall varieties of apples ripen and all prematurely when attacked by codling moth. Winter varieties exhibit no such tendencies. Whenever an apple containing a larva falls to the ground, the larva usually leaves it at once and seeks some hidden place in which to spin its cocoon. Only very rarely is it spun within the fruit. A very large proportion of the larvæ leave the fruit while it is still upon the tree, unless a heavy wind

or other agency causes it to fall unusually early, either letting themselves to the ground by silken threads or crawling from the fruit to the twigs and thence downward along the branches until a suitable place is found in which to pupate. The old neglected orchard is the delight of the codling moth. Amongst the rubbish on the ground and in the fence corners, and under the loose scaly bark of its moss covered limbs, are numerous choice spots in which it can pass through its wonderful transformations securely hidden from all foes. Many larvæ of the second generation are yet in the fruit where it is gathered and are carried with it into the storerooms. There they too find suitable place in which to pupate in cracks and crevices about the room and the packages in which the fruit is stored. In fact when such storerooms are in proximity to orchards they form a prolific source of infection in spring unless some method is employed to prevent the escape of the moths. It is also certain that the principal means by which the insect is introduced into new regions is in the packages in which infested apples or pears have been packed.

It would be interesting, and perhaps profitable, to know where all the larvæ spin their cocoons in well cared for orchards of smooth young trees. Four or five years ago, Mr. H. B. Miller, a successful orchardist of Grants Pass, suggested to me that many of them must pupate in the soil. Mr. Miller based his suggestions on the fact that very few cocoons indeed could be found on his trees; and that he believed he had obtained good results in lessening the amount of codling moth injury in his orchard by frequent cultivation. In 1898, at least 75 per cent of the Ben Davis apples in a certain orchard near Corvallis were rendered unmarketable by codling moth injuries. In fact the crop was not gathered. Hundreds of wormy apples lay on the ground under every tree. Late in the fall I examined six of these trees carefully. They were not old. The bark was smooth and healthy except for an occasional spot of apple tree anthracnose. On the six trees I found less than a half dozen cocoons. Most of these were in a piece of cloth that had been left in a crotch; only two or three were found on the trees proper and these were about old anthracnose scars. I was convinced that most of the larvæ must be secreted under clods and other objects on the ground or about the crowns of various plants; but together with an assistant, I spent several hours in searching for them without finding a single one. Neither have I ever found any in such places in well

cultivated orchards. Nevertheless I believe that in well cared for orchards of clean smooth trees, the larvæ do spin their cocoons under clods or any other objects that may lie upon the surface of the soil; and that frequent cultivation may thus be of value by destroying them or exposing them to their enemies. Aug. 15, 1900, I found one larva in its cocoon, two live pupæ and a number of empty pupæ cases in small cracks in the uncultivated soil under an apple tree. Fig. k shows a cocoon in a cell in a clod. The bark on this tree was rough and scaly and considerable rubbish lay on the ground under it. There were thus many normal places in which the larvæ could have spun their cocoons; that they chose to do so in the ground would seem to indicate that the habit is not unusual. Cooke* states that the cocoons are often found from one to six inches beneath the surface of the soil about the trunk and larger roots. Simpson† states that many are placed in cracks in the ground and that a Mr. McPherson reports having found many among the clods of earth in the orchard. Undoubtedly the larvæ prefer to pupate under scales of bark on the trunk and larger limbs or in other dry secluded places above the ground—in breeding cages they almost invariably go to the top—but it seems evident that under certain circumstances they may pupate on or beneath the surface of the soil, and that clean smooth trees and clean culture are valuable aids in the warfare against this pest.

Having found a suitable place, whether it be on trunk or branch, in barrel, box or storeroom or under a clod, the larva hollows out a little oval cavity with its jaws and proceeds to envelope itself in a thin tough cocoon of silken threads intermingled with particles of the surrounding substance. Fig. h. shows a larva in a winter cocoon, on the under surface of a piece of bark. If the cocoon is formed by a larva of the first brood, in July or early August, in two or three days it will undergo a wonderful transformation—a complete change of form. It is then a pupa. A larva of the second brood remains as a larva within its cocoon until the following spring when it too transforms to a pupa. A pupa somewhat enlarged is shown in Fig. j. Whether the change to the pupa occurs in a few days as in the first brood or is delayed until spring as in the second, the insect remains in the pupal stage only two or three weeks. Then, by wriggling movements, aided by the spines on the back of

* *Injurious Insects of the Orchard and Vineyard*, p. 102.

† *Bul. 30 N. S. Div. Ent. U. S. Dept. Agr.*

each segment, the pupa works its way out of its cocoon and is born again. It is then a most beautiful object—the moth. In breeding cages, moths of the first brood emerged Aug. 3, from cocoons that were spun July 19, and in which the larvæ pupated July 21. Moths of the second brood, which had developed from eggs deposited Sept. 5, and hatched Sept 12, emerged May 29.

To show more clearly the times at which the moths appear I have compiled the following table from breeding cage records for 1898-99. Beginning July 7, '98, when the first wormy apples were found, infested fruit was gathered from time to time throughout the season and placed in cages. The same process was followed in 1899. Careful record of the dates of appearance of the moths was kept throughout the fall of 1898. In 1899, during my absence the records were efficiently kept by Mr. W. J. Gilstrap, a student assistant, until Sept. 7, when he resigned. However, on Sept. 2, he observed that many moths of the second generation had not emerged. It is, therefore, probable that they would have continued to emerge at least until Sept. 15, as in 1898.

Table Showing Dates of Appearance of Moths in 1898-99.

1898.		1899.					
Date.	No. of Moths.	Date.	No. of Moths.	Date.	No. of Moths.	Date.	No. of Moths.
Aug. 3.....	5	April 10.....	1	May 23.....	3	Aug. 5.....	3
5.....	2	21.....	4	25.....	3	7.....	4
6.....	1	22.....	1	27.....	5	8.....	1
11.....	6	29.....	1	29.....	3	9.....	3
14.....	4	May 3.....	1	31.....	1	12.....	5
19.....	6	5.....	2	June 1.....	4	15.....	2
Absent until		8.....	9	5.....	4	18.....	3
Sept. 3.....	44	9.....	2	27.....	10	19.....	1
5.....	3	13.....	4	29.....	1	24.....	6
8.....	2	15.....	6	30.....	1	28.....	2
14.....	2	16.....	3	July 24*.....	1	31.....	2
		18.....	2	25.....	1	Sept. 4.....	1
		19.....	4	Aug. 4.....	6	6.....	1
		22.....	4			7.....	1

* The moths recorded July 24-25 were captured in storerooms and may be extra late individuals of the first brood or early ones of the second—probably the latter.

Natural Enemies.

As a moth, flying only at night; as a larva, living in a citadel both entrances to which are barricaded; or as larva and pupa, hidden securely away in the most secluded spots and rendered almost invisible by the protective coloring of its cocoons; it would seem

that the codling moth should be safe from all foes. Nevertheless the mortality is great in each of its various stages.

I have observed many shrivelled eggs that did not hatch. The same condition has been noted by others, notably Koebele,* Washburn† and Simpson.‡ Washburn states that "the moth lays many eggs but apparently only a certain proportion of them develop." He thus conveys the impression that the mortality is due to lack of fertilization. Simpson attributes it to climatic conditions. Both may be right. I have noticed that in breeding cages protected from the sun nearly every egg hatches. In California and in the east, a minute parasitic insect lives in and destroys a few of the eggs. It is probably present in Oregon but I have as yet not detected it.

In Utah a wasp is reported to collect the larvæ and store them in its burrows, while the fruit in a neighboring orchard was almost free from injury. In California, another wasp is said to pull the larvæ from the apples; while in Indiana the same good office is performed by the downy woodpecker. It is not at all uncommon at Corvallis to find a considerable percentage of the larvæ dead in the fruit; some killed by a fungous disease; others evidently by a bacterium.

After leaving the fruit, and while seeking a place in which to pupate the larvæ are subject to the attacks of numerous predaceous and parasitic insects and many birds, which also continue to prey upon them both as larvæ and pupæ after they are hidden away in there cocoons.

Even the moths are captured, while on the wing, by bats and probably many fall a prey to birds, both while at rest during the day and while on the wing at night. At least fifteen species of insects, one hair-snake, a fungous disease, a bacterial disease and many species of birds are known to prey upon the codling moth during some stage of its existance, and yet it ranks as the most destructive apple pest.

The idea of controlling crop pests by their natural enemies is a popular one; and there are not lacking, enthusiasts who advocate, with little reason, the introduction of this or that particular enemy, or the artificial culture and use of one already present, as a cheap and efficient method of controlling the codling moth.

In July, 1898, nearly 80 per cent of the larvæ infesting the Waxen

*Bul. 22 Div. Ent. U. S. Dept. Agr.

†Bul. 26 Or. Expt. Sta.

‡Bul. 30 N. S. Div. Ent. U. S. Dept. Agr.

apples on a certain tree were killed by disease. Two distinct types of disease were noticeable; one a fungus which produced a solid or mummified condition of the larvæ; the other evidently a bacterium which induced decay. I was, at first, impressed with the belief that organisms which naturally produced such a great mortality among the larvæ of the codling moth might be successfully used in orchard practice; but when early in August, the mortality diminished to about 5 per cent or less, while the larvæ were much more abundant, and there was thus more opportunity for the spread of the contagion, I abandoned the idea. It was only too evident that the organisms were too dependent upon favorable conditions for their development, to be reliable agents in insect warfare. Spraying the trees with cultures of these diseases might give good results under certain circumstances; but the results, being so dependent upon conditions, would be uncertain and the practice therefore unsafe. In all economic work with diseases of insects, two conditions have been found essential to success; the climatic conditions must be favorable for the development of the disease and the insect must be gregarious. The first condition cannot be controlled; the second does not exist in this particular instance, the larvæ being not only solitary in their habits but deeply buried in the fruit. I, therefore, do not believe the use of disease germs in controlling codling moth can be made practical.

I fully agree with Slingerland* that "the most efficient aids to man in controlling the codling moth are birds. * * * Any one who tries to collect the apple-worm on the trunks of trees in early spring, will be surprised to find how many empty cocoons there will be. Usually, however, a tell-tale hole through the bark into the cocoon explains the absence of its occupant. Our observations lead us to agree with Riley and Walsh that 'almost all the cocoons of the moth that have been constructed in the autumn on the trunks and limbs of apple trees, are gutted before the spring opens.' * * * One finds such an astonishingly large number of empty cocoons that it would seem as though the birds must get the larger proportion of the worms which go into hibernation in the fall." Probably the flickers and nuthatches should be given first rank as codling moth destroyers, but they are ably seconded by jays, chickadees, wrens, sparrows, swallows, titmice, kinglets and bluebirds.

Notwithstanding this splendid array of feathered friends of the

* Bul. 142 Cornell Expt. Sta.



THE CODLING MOTH. (Original.)

THE CODLING MOTH.

Fig. b. Moth resting on apple. Reduced one-half.

Fig. e. Wormy apple showing familiar mass of frass at calyx end. Reduced one-half.

Fig. f. Mature apple showing spot where a second brood larva had entered at the side. Reduced one-half.

Fig. g. Interior of wormy apple showing point of entrance at calyx, channel to the core, excavation about the core, exit passage, in which is the larva, leading to the surface of the fruit where it is closed with a plug of frass and silken threads. Reduced to one-third natural size.

Fig. h. Winter quarters disturbed. A winter cocoon on the under surface of a piece of apple bark has been torn open to show the inclosed hibernating larva. Enlarged $1\frac{1}{2}$ dia.

orchardists, there has been considerable agitation, in this and neighboring states, in favor of importing the Kohlmeise, *Parus major*, from Germany. It is even reported that the last legislature of Utah appropriated \$500 to be expended in making such an importation. The advocates of such an experiment claim that the Kohlmeise is the natural enemy of the codling moth, that in Germany it keeps the moth in subjection, and that if imported to this country it would probably be as effective here.

I believe such an importation would be a dangerous and an unnecessary experiment; unnecessary because we have already in this state three native species of birds which belong to the same genus as the Kohlmeise, and which, in all probability, have very similar habits, viz, The Oregon Chickadee, *Parus atricapillus occidentalis*, the Mountain chickadee *P. gambeli*, and the Chestnut-backed chickadee, *P. rufescens*; dangerous because it is always uncertain what changes in habits may occur when an animal, be it ever so harmless in its native habitat, is introduced to new conditions. In support of this statement it is only necessary to call attention to the introduction of the English sparrow into the United States, the mongoose into Jamaica, the European rabbit into Australia and the starling into New Zealand. Those interested in the subject are referred to an article by Dr. T. S. Palmer* on "The Danger of Introducing Noxious Animals and Birds."

Regarding the Kohlmeise, Dr. Palmer writes as follows:

"'Kohlmeise' is the German name of the great titmouse of Europe (*Parus major*), and this designation is used to some extent in the United States. The Kohlmeise is common over the whole of Europe as far north as the Arctic circle and also in Siberia. * * * The Kohlmeise has recently attracted attention on account of its alleged value as a destroyer of the codling moth (*Carpocapsa pomonella*), particularly in Germany, where it is reported to protect apple trees in large measure from the attacks of this destructive insect. But although several German authors regard it as a most useful species, there seems to be no satisfactory evidence that it is partial to the codling moth, or in fact that it ever feeds on the moth to any great extent. In Great Britain where the Kohlmeise is also a resident and generally distributed, its presence has not been sufficient to exterminate the codling moth or even to hold this pest in check. On the other hand, it is said to attack small and weakly

* Yearbook U. S. Dept. Agr., 1898.

birds, splitting open their skulls with its beak to get at the brains, and doing more or less damage to fruit, particularly pears. One English observer reported that all the pears in his garden had to be enclosed in muslin bags to protect them from the birds which would otherwise eat a considerable part of the fruit before it was ripe. Another reported that the great titmouse spoiled most of a limited crop of apples, and then began on the pears, boring a small hole near the stem, and passing from one pear to another until every one of forty or fifty trees had been damaged. It also attacked figs, scooping them out before they were ripe." In this country the Kohlmeise might not develop the undesirable traits it has exhibited in England; but its character is not above suspicion. Far better to expend our energies in protecting and fostering the birds we have, than in introducing one that might itself become a pest. Well cultivated and well pruned orchards, free from weeds and seeds and underbrush, are not attractive places to birds, and it is at least doubtful whether the Kohlmeise would remain in them. In Germany, where it is said to do the most good, there are practically no commercial orchards.

I believe there is little prospect that any practical benefit will come from the introduction of foreign enemies of the codling moth, or from attempts to increase the usefulness of those already present. The "strenuous life" of the fruit grower alone will protect his fruit. He must be persistent in the use of the best known remedies. The most successful orchardists of the state now rely almost wholly upon spraying.

The Codling Moth and Late Spraying.

The fundamental fact that must be considered by those who aim to control the codling moth by spraying, is that in this western country the larvæ are very abundant late in the season. In the Willamette Valley, and I believe the same is true in the other apple growing regions of the state, the greatest loss from codling moth injury occurs after Aug. 1. This fact necessitates a radical departure from the practice which has given such satisfactory results in the east.

Since Cook* first demonstrated the value of the arsenical sprays as a preventive of codling moth injury to apples, early spraying has been the almost universal practice, alike of the fruit grower and the

* Am. Entomologist, Vol. 3, 1880.

entomologist. "Apply early, just after the blossoms fall," wrote Cook; and the advice has been echoed—and followed—ever since. The test of years has only served to demonstrate its value. It has been worth millions of dollars to apple growers all over the land. Professor Cook found this one application so effective that he doubted whether it would be best or necessary to make another. Subsequent experience did not fully sustain his expectations.

Forbes* as a result of a very carefully conducted series of experiments covering two seasons, during the first of which certain trees were sprayed eight times, arrived at the conclusion that seventy per cent of the loss commonly caused by the codling moth may be prevented by spraying with Paris green once or twice in early spring as soon as the fruit is set and before it turns downward on the stem; but that "certainly no appreciable effect was produced by spraying during the life of the second brood." Goff† obtained practically the same result. Munson‡ as a result of some careful work noted that a large proportion of fruits infested had been attacked by the second brood but concluded that to spray for this brood is hardly practicable. Lodeman§ states that it is not advisable to apply Paris green more than twice in a season unless the rainfall is very heavy or continuous. Practically the same conclusion has been arrived at by all experimenters in the eastern United States. The subject has been finally summarized by Slingerland|| who concluded that if no rains occur between the time of the application and the closing of the calyx lobes, one spraying just after the blossoms fall is just as effective as half a dozen later applications.

These conclusions, arrived at as the result of years of observation, and the successful experience of many men are not supported by results obtained in this state. Early spraying alone will not save the fruit. It is not only practicable but necessary to fight the second brood. Personally, I am of the opinion that the early applications, soon after the petals fall, are of very little value in the Willamette Valley. Here the blossoms usually fall not later than May 10. If the application is to be made before the calyx lobes close, spraying must not be delayed more than a few days after this date. The first larvæ enter the fruit at Corvallis rarely before June 25. I have as yet had no analysis made, but in view of our usually

* Fifteenth Rept. Ill. State Ent., 1885-6.

† Fourth Rept. N. Y. Agr. Expt. Sta., 1885.

‡ Rept. Maine Expt. Sta., 1891.

§ Bul. 60, Cornell Expt. Sta.

|| Bul. 142, Cornell Expt. Sta.

large rainfall after the petals drop, I am strongly of the opinion that by the time the first larvæ are ready to enter the fruit practically none of the poison of these early sprays remain either in the calyx cup or elsewhere upon the fruit. Nevertheless, contrary to eastern experience though it may be, good results are obtained by the use of the spray pump, by keeping everlastingly at it. To quote from Mr. Smith's article on spraying, in the appendix, "By this sign we conquer." In warmer and dryer portions of the state where the larvæ begin to appear sooner the early applications are undoubtedly of great value. Even in the Willamette Valley it is not best to omit them until their value has been further tested.

The comparative value of the different applications can best be shown by reference to the following table which records the result of experimental spraying in the college orchard in 1898. Five rows containing 134 trees were selected for the experiment. Of these 50 failed to produce fruit, or were early varieties of which no records were kept, since the particular end in view was to test the effect of a late application on larvæ of the second brood. There were thus included in the experiment 84 trees of fall and winter varieties. These trees with certain exceptions were sprayed four times with Bordeaux mixture to which one pound of Paris green was added to each 200 gallons. The applications were made May 13, June 11, June 25, and Aug. 11, and at each application certain trees were omitted. In the column marked "No. of Applications" the figures opposite any particular tree indicate which of the sprayings that tree received. Thus, 1 stands for the first application, May 13; 2 for the second, June 11, etc. In like manner, 1, 2, 3, 4 indicates that the tree received all four applications; 2, 3, that it received only the second and third. At the time the first application was made the condition of the calyx was noted for each variety and this is recorded in the column marked "Condition of Calyx," as open or closed. Immediately after the third application I, personally, counted the apples on each tree, and again July 20 went over them and counted all that showed indications of being infested by larvæ of the first brood. When the fruit was gathered it was carefully examined, the apples that showed the least indication of injury counted, and the percentage of wormy to sound fruit estimated.

Table Showing Relative Effects of Early and Late Spraying in 1898.

VARIETY	Condition of Calyx	No. of Applications	Total No. of Apples	No. Wormy July 20	Per Cent Wormy	No. Wormy when Gathered	Per Cent Wormy	Per Cent Sound
Grimes' Golden	Open	1, 2, 3, 4	190	1	.54	4	2.4	98
"	"	1, 2, 3, 4	228	0	0.	11	4.6	95
"	"	1, 2, 3, 4	815	0	0.	18	2.4	98
White Pippin	"	1, 2, 3, 4	715	1	.14	36	5.	95
"	"	1, 2, 3, 4	500	1	2.	23	4.5	95
"	"	1, 2, 3, 4	200	0	0.	57	28.5	71
Shiawassee	"	1, 2, 3, 4	365	0	0.	35	10.	90
"	"	1, 2, 3, 4	360	0	0.	9	2.5	97
"	"	1, 2, 3, 4	185	0	0.	53	40.	60
Whitney's 20	"	1, 2, 3, 4	825	5	.6	17	2.	98
"	"	1, 2, 3, 4	425	2	.5	0		
Fall Jemmett	"	2, 3, 4	525	13	2.5	107	20.	80
"	"	2, 3, 4	450	2	.5	34	7.5	92
"	"	2, 3, 4	570	2	.35	27	5.	95
Fallwater	"	1, 2, 3, 4	53	0	0.	7	13.	87
Pumpkin Russet	"	1, 2, 3, 4	150	9	.6	16	10.	90
"	"	1, 2, 3, 4	285	0	0.	33	11.	89
"	"	1, 2, 3, 4	125	1	.8	10	8.	92
Rambo	"	1, 2, 3, 4	275	1	.34			
"	"	1, 2, 3, 4	310	0	0.			
"	"	1, 2, 3, 4	325	1	.8			
Wallbridge	"	1, 2, 3, 4	295	0	0.	0	0.	100
"	"	1, 2, 3, 4	400	0	0.	2	.5	99.5
"	"	1, 2, 3, 4	152	2	1.3	0	0.	100
Wolf River	"	1, 2, 3, 4	112	3	3.	2	2.	98
"	"	1, 2, 3, 4	185	2	1.4	0	0.	100
"	"	1, 2, 3, 4	286	3	1.	0	0.	100
"	"	1, 2, 3, 4	200	1	.5	0	0.	100
"	"	1, 2, 3, 4	100	2	2.	0	0.	100
Yellow Transparent	"	1, 2, 3, 4	575	8	1.4	0	0.	100
Sculard	"	1, 2, 3, 4	285	9	3.2	2	1.	99
Red Astrachan	"	1, 2, 3, 4	88	1	1.2			
Oldenburg	"	0	336	0	0.	73	22.—	83
"	"	2, 3, 4	475	1	.2	0	0.	100
"	"	1, 2, 3, 4	160	4	2.5	0	0.	100
"	"	1, 2, 3, 4	50	5	10.			
"	"	1, 2, 3, 4	137	6	4.4	20	14.5	85.5
May	"	1, 2, 3, 4	122	0	0.	0	0.	100
"	"	1, 2, 3, 4	105	1	1.	6	6.	94
"	"	1, 2, 3, 4	155	0	0.	0	0.	100
Delaware	"	1, 2, 3, 4	100	0	0.	10	10.	90
"	"	1, 2, 3, 4	135	1	.7	2	1.5	98
McMahan's White	"	1, 2, 3, 4	345	1	.3	18	5.2	95
"	"	1, 2, 3, 4	297	3	1.	27	10.	90
"	"	1, 2, 3, 4	253	0	0.	21	8.	92
Scott's Winter	Closed	0	627	15	2.3	105	16.	84
"	"	2, 3, 4	285	2	.7	35	12.	88
"	"	2, 3, 4	385	4	1.	25	6.5	93.5
Summer Queen	Open	1, 2, 3, 4	120	0	0.			
"	"	1, 2, 3, 4	180	0	0.	0	0.	100
"	"	1, 2, 3, 4	195	1	.5	0	0.	100
Bailey Sweet	"	1, 2, 3, 4	58	0	0.	0	0.	100
"	"	1, 2, 3, 4	175	0	0.	0	0.	100
Colvert	"	1, 2, 3, 4	175	0	0.	7	4.	96
"	"	1, 2, 3, 4	350	0	0.	0	0.	100
"	"	1, 2, 3, 4	14	0	0.	0	0.	100
Gano	"	1, 2, 3, 4	285	0	0.			
"	"	1, 2, 3, 4	300	2	.7			
"	"	1, 2, 3, 4	350	3	1.			
Salome	"	1, 2, 3, 4	30	0	0.	8	25.	75
"	"	1, 2, 3, 4	125	0	0.	35	25.	75
Pewaukee	Closed	1, 2, 3, 4	250	2	.8	10	4.	96
"	"	1, 2, 3, 4	225	3	1.3	7	3.	97
"	"	1, 2, 3, 4	50	0	0.	2	4.	96
Jewett's Red	"	1, 2, 3, 4	150	1	.7	12	8.	92
"	"	1, 2, 3, 4	175	0	0.	15	9.	91
"	"	1, 2, 3, 4	400	0	0.	8	2.	98

Table Showing Relative Effects of Early and Late Spraying in 1898.—Concluded.

VARIETY	Condition of Calyx	No. of Applications	Total No. of Apples	No. Wormy July 20	Per Cent Wormy	No. Wormy when Gathered	Per Cent Wormy	Per Cent Sound
Pryor's Red	Open	1, 2, 3, 4	500	1	2.	9	2.	98
"	"	1, 2, 3, 4	750	0	0.	6	8.	99
"	"	0	800	20	2.5	87	23.†	77
Mann	"	2, 3, 4	175	2	1.	6	3.	97
Early Strawberry	Closed	1, 2, 3, 4	210	1	.5	3	1.5	98.5
York Imperial	"	1, 2, 3, 4	175	1	.5	13	7.5	92.5
"	"	1, 2, 3, 4	560	2	3	16	2.5	97.5
Twenty Ounce	"	1, 2, 3, 4	50	2	4.			
Ortley	"	1, 2, 3, 4	75	0	0.	4	5.	95
"	"	1, 2, 3, 4	200	0	0.	12	6.	94
Taylor's Red	Open	1, 2, 3, 4	80	0	0.	2	2.5	97.5
Longfellow	"	1, 2	620	1	.2	106	16.†	84
Maiden's Blush	Closed	0	125	0	0.	76	60.	40
"	"	2, 3	150	1	.7	57	38.	62
Saint Lawrence	"	2, 3, 4	450	0	0.	15	3.†	97

From the above table several interesting facts may be deduced.

(1) Of the 29,958 apples produced on the 84 trees less than one (.6†) per cent was wormy July 20, and but little more than five per cent was infested when the fruit was gathered. The injury varied from nothing on certain sprayed trees to 60 per cent on one not sprayed.

(2) The five check trees which were not sprayed produced 2,413 apples of which 23 per cent were wormy.

(3) Two trees received only the first and second applications. They produced 785 apples of which 20 per cent were injured by the apple worm.

(4) One tree received the second and the third applications, the first and the fourth being omitted. This tree produced 150 apples of which 38 per cent were infested.

(5) From seven trees only the first spraying was omitted. On these trees less than 5 per cent of the 2,405 apples produced were wormy.

(6) Sixty nine trees received all four applications, and but slightly more than 3 per cent of the 16,820 apples produced were wormy.

(7) Perhaps the most striking fact brought out, and the one that probably explains the poor results from the early applications, is the extremely small percentage of injury that had occurred up to July 20. On only one tree did it amount to as much as 4 per cent.

Even on the trees not sprayed, the average loss up to that time, was less than 2 per cent.

(8) The results of the one season's experiments indicate that the first application was valueless, that the second and possibly the third were nearly so, and that the fourth was the important one. That late applications are important have been verified by our later experience and by the results obtained by fruit growers; but the inefficiency of the early applications should not be considered as proved, even for the Willamette Valley without further evidence, although the results obtained taken in connection with the fact that the larvæ do not begin to infest the fruit much before July 1, at least indicate their lack of value for this locality. In dryer and warmer parts of the state, where the fruit is attacked earlier, the first applications are of undoubted value.

The results of the season's work indicate very clearly the great value of the fourth application. Nevertheless, the experiments were not entirely satisfactory. The college orchard, being an experimental one, contains a large number of varieties of but two or three trees each. While this was perhaps of value in showing the comparative effect of the sprays on the different varieties, it made it impossible to obtain a sufficient number of trees of the same variety on which to test the relative value of the different applications under like conditions. It was also unfortunate that some of the trees selected as checks failed to set fruit. Thus it is that the results from making the first and second applications, only, were obtained on but two trees, and those from the second and third applications, only, were obtained on but one. The value of these early applications therefore cannot be considered as satisfactorily proved or disproved.

In the spring of 1899, an attempt was made to repeat the experiments under more favorable conditions, by entering into an arrangement for coöperative work in the orchard of Mr. Thos. Whitehorn. The orchard is conveniently located and consists principally of but two varieties of apples, the Newtown Pippin and the Ben Davis. The apple crop for this season being an almost entire failure, similar arrangements were made for the season of 1900 for coöperative work in Mr. Whitehorn's orchard and in a small orchard of Baldwins controlled by Mr. B. F. Irvine. These orchards were each sprayed four times, for codling moth, with Bordeaux mixture and Paris green. The first application was made May 7-14; the second June

22-27; the third July 26-28; the fourth Aug. 31-Sept. 1. In addition, the Ben Davis trees which had been sprayed June 23, were re-sprayed June 27, on account of a heavy shower having fallen on June 24.

In each of these orchards certain rows or trees were left untreated at each spraying that we might again test the comparative value of the different applications. Owing to an oversight, however, notes on the amount of injury were not taken until the fruit had been gathered, when it was found impossible to satisfactorily separate the various lots according to the applications they had received. While it was, therefore, impossible to compare the value of the different syrayings, the results are not without value since they give added proof of the value of spraying in general. Although they obtained an additional spraying on June 27, the poorest results were obtained with the Ben Davis of which approximately 30 per cent were wormy. The Newtown Pippins, standing beside them in the same orchard, were almost entirely free from codling moth injury—not over two per cent being infested. In the Baldwin orchard the injury did not exceed one or two per cent. In fact, Mr. Irvine reported that “in several hundred bushels less than half a dozen apples affected with worm were found. On a few trees, a few rods distant from the others, which were not sprayed the fruit was so wormy that it was unfit to use. None of it was gathered.”

It should be remembered that the above work was experimental. Its object was to test the value of late applications of arsenicals for the codling moth and incidentally to determine the least number of applications that would give satisfactory results. Although we obtained good results by spraying only four times, orchardists generally will undoubtedly get better results by making five or six applications. The habits of the moth vary with the year and with the locality to such an extent that it is impossible to give definite instructions as to when these applications should be made. For the present or until futher experiments shall have proved its efficiency or inefficiency we shall continue to advise that the first application be made within a week after the petals fall and before the calyx lobes close. Each grower must determine for himself when the other application must be made. The idea should be to keep the fruit thoroughly coated with poison from the time the *very first* eggs can be detected on the apple in spring until the middle of September. Every worm that gets into the calyx or through the skin of the





Spraying by Gasoline Power in Orchard of Olwell Bros., Central Point, Oregon.

apple before the poison is applied is beyond its reach and the chances are that it will pass through its transformations and multiply fifty or a hundred fold in the next generation. Every apple grower, then, should learn to recognize the eggs of the codling moth and should start his spray pump as soon as they are detected. If he will not take the trouble to become acquainted with them the pump should be started at the earliest possible moment after the first indications of the presence of the worm in the fruit can be detected, and thereafter the orchard should be sprayed every two or three weeks during the season. In case a heavy shower follows any application the orchard should be at once resprayed. By a thorough study of the habits of the moth in his locality one can learn to vary the length of the periods between the different applications so that the fruit will be most thoroughly coated with poison at the times that egg laying is most active. Thus at Corvallis, I have found that for the first brood this is between June 20-25 and July 10-15, and for the second brood from about Aug. 10 to Sept. 15. We shall, therefore, in the future, take particular pains to keep the fruit thoroughly covered during these two periods.

The methods of successful spraying are so well described in the two articles in the appendix—one by Hon. E. L. Smith, a successful fruit grower and President of the State Board of Horticulture, the other by Hon. John D. Olwell, one of the most extensive and successful apple growers in the state, and the first grower in the state to use a power spraying outfit. Both of these men have had extensive experience with spraying that pays and whatever advice they give can be safely followed in their respective localities. It will be noted that Mr. Smith uses the arsenite of lime,* prepared after a slightly modified Kedzie† formula, while Mr. Olwell uses a mixture of Paris green and London purple. I have principally used Paris green. So far as efficiency is concerned it probably makes little or no difference which of these poisons is used. The arsenite of lime is cheaper than the other two and is more easily held in suspension. It is extensively used at Hood River and has given general satisfaction. Paris green and London purple are too well known to require any further notice than to say that the former

* Sometimes termed arsenite of soda.

† First recommended by Dr. R. C. Kedzie of the Michigan Agricultural College. The arsenic and sal soda are boiled together until a clear solution of arsenite of soda is formed. This is exceedingly injurious to foliage. It therefore must always be applied in lime water or in Bordeaux with an excess of lime since the lime precipitates the arsenic as insoluble arsenite of lime, thereby neutralizing its injurious action. In case the arsenic does not all become precipitated injury to foliage may occur.

is more uniform in the amount of arsenious acid it contains than is the latter, and whenever the two have been carefully tested side by side has invariably given better results.

It will also be observed that both Mr. Smith and Mr. Olwell apply the poison in a mixture of lime and water. In the Willamette Valley and along the coast, it should be applied in Bordeaux mixture for all sprayings after the petals fall and previous to July 1. First, because the Bordeaux is necessary to control the apple scab and other fungous diseases; second, because it causes the poison to adhere to the fruit better than does any other substance. After July 1, it is best to use the lime and poison only, as the Bordeaux is not necessary and stains the fruit. To successfully combat both apple scab and the codling moth, it is advised to spray with plain Bordeaux just as the leaf buds are unfolding, and again just as the blossoms begin to open. Within a week after the petals fall the trees should be sprayed with Bordeaux to which one of the above poisons has been added, the same amount of poison being used as when it is applied in water. So far as codling moth is concerned, no other applications are necessary in the Willamette Valley until well towards the end of June when the first eggs are deposited, but if it is desired to fight the scab fungus, as well, the orchard should be again sprayed with Bordeaux in ten days or two weeks after the application last mentioned. The poison may also be added to the Bordeaux for this application to kill any leaf-eating insects that may be present. In spraying for apple scab, the idea should be to keep every part of the tree thoroughly protected by Bordeaux from the time the leaves first appear until the spring rains are over. The number and frequency of the applications will necessarily vary with the amount of rainfall. Likewise, in spraying for the codling moth, the idea should be to have every part of every apple coated with poison from the time the first eggs hatch until the fruit is nearly ready to gather. It is not necessary to add poison to the Bordeaux before the petals fall, nor is it necessary to use Bordeaux with the poison after July 1. Between these dates the two should be used together, one pound of Paris green being added to each 200 gallons of Bordeaux. (Arsenite of lime or the Paris green-London purple mixture can of course be used in place of the Paris green).

We have usually obtained better results from Bordeaux mixture by using more lime in its preparation than is commonly recommended. To make 50 gallons of Bordeaux, dissolve 6 lbs. of copper

sulphate in 25 gals. water. Slowly slake 6-8 lbs. of lime (air-slaked lime must not be used) and add enough water to make 25 gals. Then slowly pour the two dilute mixtures together. If much spraying is to be done time can be saved by preparing stock solutions of the copper sulphate and the lime, as follows: Weigh out 100 lbs. of copper sulphate, put it in a coarse sack and hang it near the top in a 50 gal. cask. Fill the cask with water and allow to stand until the bluestone is all dissolved. Then refill the cask to the 50 gal. mark. Each gallon of the solution will thus contain 2 lbs. of the copper sulphate. In another 50 gal. cask slowly slake 100 lbs. of lime, after which add enough water to make 50 gals. Each gallon will therefore contain 2 lbs. of lime. To prepare 50 gals. of Bordeaux mixture, dilute 3 gals. of the sulphate of copper solution with 22 gals. of water. Likewise, dilute 3-4 gals. of the milk of lime with enough water to make 25 gals. Then pour the two dilute solutions together. Under no conditions should the undiluted stock solutions be mixed.

Other Preventive Measures.

Spraying has come to be the chief means of protecting fruit from injury by the codling moth. In this state it is now practically the only means employed. If it be done intelligently and be persisted in, and if a good quality of poison be used, the result should be at least 85-95 per cent of fruit free from worms. Nevertheless, one should not overlook the facts that clean smooth trees and clean cultivation are efficient supplements to spraying; that if sheep or hogs are allowed to run in the orchard, they will devour the fallen fruit with many worms included; that closed screens at the windows and doors of storerooms in which infested fruit has been kept, means imprisonment for life to all moths that emerge therein in spring. Some good authorities also recommend that the old "banding system" be used as a supplement to spraying. This consists in folding a piece of thick dark colored cloth to make bands 4-6 inches wide and fastening these tightly about the trunk of each tree about two feet above the ground. This simply furnishes the larvæ convenient places in which to pupate. After the first brood larvæ begin to leave the fruit these bands should be examined every 6-8 days until about Sept. 15, and all the insects killed. Further examination of the bands can then be deferred until sometime after the fruit has all been gathered, when they should again be gone over and all the hibernating larvæ killed. The expense of banding is hardly necessary if the spraying has been carefully and intelligently done.

APPENDIX.

SPRAYING.

HON. E. L. SMITH.

The spray pump might well be adopted as the emblem of the fruit grower, and on it inscribed that old legend, "By this sign we conquer."

If there is any considerable fruit-growing section, independent of its use, it is unknown to me and thorough spraying has become one of the most essential factors in successful orcharding.

The subject being one of prime importance, and as many discouraging results have been reported, it may be well to compare experiences and inform ourselves as to those conditions that will insure success.

My own experience has demonstrated that these conditions are substantially as follows:

First, the material must be unadulterated and of regulation strength. Lime forms a part of many spraying compounds and its efficiency is greatly lessened if it becomes air-slaked before using. I have frequently been asked as to the relative merits of Paris green and the arsenite of soda, for codling moth. I believe they are equally effective if properly prepared and applied.

Second the spraying must be begun at the proper time and continued at regular intervals. For the apple moth, for the best results, spray fruit as soon as petals have fallen, and then at regular intervals of two weeks to middle of September.

I am aware that so eminent an authority as Prof. Slingerland, holds, that subsequent sprayings after the two first are useless. His idea is that the calyx of the apple being cup-shaped will hold sufficient poison to kill the young larvæ but that we cannot coat the sides of the apple with a sufficient amount to be effective.

I cannot concur in this conclusion. The calyx of many varieties of apples never closes and I believe it is well to renew the poison that may have been dissipated at the eye of the apple. Again the moth lays many eggs on the upper surface of the leaves and may we not coat these leaves and even the fruit itself with such an amount of poison-bearing lime as to afford a very uncomfortable diet for the newly born larvæ. An opinion has obtained among many growers that the lime itself if not an insecticide is at least a deterrent and for that reason we use from 6 to 8 lbs. freshly slaked to 50 gallons of spray.

Late sprayings are important from the fact that the moth is never so much in evidence as between the 15th day of August and the 15th day of September.

Third, the spraying must be done thoroughly to secure best results. From my point of observation, on the top of the spray-tank, I find that there is a tendency to slight the center and the highest branches of the trees by the men who guide the nozzles. Again story-telling on the part of the sprayers does not work well in my orchard; their entire attention must be centered on their work, and thoroughness ceases when talking begins.

I repeat that the cardinal principles of successful spraying are materials of full strength, carefully compounded and applied at the right time, in a thorough manner.

I do not hesitate to say that failures or partial failures are usually on account of non-compliance with these indispensable conditions. If the orchard is a large one a power-pump is of great utility. There are several kinds of these pumps in use, the most effective in my opinion being those run by small engines, usually gasoline.

These engines afford a constant, and any desired power, agitate the liquid thoroughly, which is especially necessary when Paris green is used as it is not soluble in water, and force the spray between the leaves and into the clusters of apples far better than can be done with the hand-pump. The engine, however, must be covered to protect it from the flying spray, adds much to the weight of the load and requires a man with some knowledge of mechanics to keep it in order.

During the past season I used what is styled "The Orchard Monarch," manufactured by The Field Force Pump Company of Lockport, New York. This machine is operated by a crank shaft and sprocket-gear attached to the hind wheels of the wagon. In driving from tree to tree the pressure is pumped up automatically and at the same time the power pump forces the liquid from the tank holding 150 gallons into a chamber of 12 gallons capacity.

The objection I have found to this machine is that when the team stops and the spray is turned on the pressure falls rapidly, and that it will not generate sufficient power in going from tree to tree, planted 24 to 30 feet apart, and has to be assisted by a hand pump conveniently placed near the driver. In a five year old orchard I was able to do excellent work, using two double vermorer nozzles, without stopping the team, covering 17 acres easily in a day. On the whole I do not regret the purchase of the Orchard Monarch as it saves a great amount of hand pumping. I conclude, however, that we have not yet reached the acme in power-spraying, and look forward confidently to the time when we will do our pumping with the light but powerful storage battery, the latest and most important of all Mr. Edison's inventions, as he declares.

Hood River apple growers, so far as I know with a single exception, use the arsenite of soda application for the moth and are using a greater proportion of white arsenic than in former years and without injury to foliage.

The past season I followed this formula,

Water	1 gallon
White arsenic	1 pound
Sal soda.....	2 pounds

Boil fifteen minutes or until the liquid is clear. Add an amount of water equal to that evaporated, making one full gallon of arsenite, and use $1\frac{1}{2}$ pints to 50 gallons of water to which has been added 6 lbs. of fresh slaked lime. This spray has been used for the past four years with average results of 90 to 95 per cent of fruit free from the moth.

In Southern Oregon equally favorable results are obtained, using Paris green and London purple. In Missouri quite a number favor a dry powder claiming that it is easier and more rapidly applied. If you want to test it make a powder composed of 10 pounds lime, 1 pound Paris green, 1 pound Bordeaux, and apply with a powder-gun when the dew is on the leaves.

I deduce some conclusions from the past season's spraying.

Two years ago in a young orchard four years old there was so little fruit that I did not spray it—result, 50 boxes of apples, fully one-half damaged by codling moth. Sprayed same orchard six times last season and gathered over 500 boxes of fruit. Examined critically 14 boxes of Grimes' Golden Pippins and found but five wormy apples, the rest in about the same proportion as near as I could judge. It is safe to say that 99 per cent were not wormy. In a neighbor's young orchard not more than 20 rods distant, no spraying was done; result, over a hundred boxes, nearly three-fourths ruined by the codling moth.

I conclude from these facts that an orchard can be kept free from the apple moth, even when it is adjacent to other orchards where it abounds. In an older orchard did not fare so well. Ben Davis fully one-fourth wormy. The Ben Davis grows in clusters and so closely that the liquid cannot be forced between apples and the moth improved the opportunity.

I have 200 Salome trees which bore too great a harvest in 1900; last year so few that I did not think it would pay to spray them; estimated that there would be fifteen bushels on these trees. After gathering my main crop thought I would pick these Salomes but on examination found scarcely an apple that the moth had not penetrated. Sprayed the adjacent rows and got 90 per cent clean fruit.

I conclude from this experience that spraying pays. That it is almost impossible to save apples growing in clusters like the Ben Davis and that the codling moth is deficient in taste, so far as this variety is concerned.

I frequently found that when an apple rested on a limb, there was the moth between the limb and the apple. To secure best results the apple must be so exposed that the spray-liquid can reach every portion of it.

METHOD OF SPRAYING FOR THE CODLING MOTH.

HON. JOHN D. OLWELL.

The demand is always for the best. If the fruit-grower wants a demand for the product of his orchard, he must produce the best. He must defend his orchard against all pests that prey on trees; and this is accomplished by the intelligent use of the spray pump. To do thorough and successful work, the hand spray pump must be abandoned, relegated to the past, like the sickle, the cradle, the flail, and other machinery of primitive days. The gasoline spray machine has come to stay; it is one of the greatest factors in the growing of fruit. It has practically revolutionized spraying, being economical, rapid, and thorough. One team hauls the engine, pump and tank of water of one hundred and twenty gallons capacity. One team and man, with water tank on his wagon, hauls water to the spraying tank—the water is transferred to the spraying tank in a moment by a pump attached to and run by the engine. The agitator on the spraying tank is geared by a bevel wheel, and run by a small shaft and pinion, and the poison is at all times kept in solution. Great care is exercised in procuring good poison, always getting that which is free from raw arsenic as much as possible. As a rule, this is not an easy task, as many adulterated brands are on the market. We procure samples and submit them to microscopic tests, and usually no difficulty is experienced in detecting the spurious article. The quality of the poison being assured, our next step is to go to work.

The proportions of poisons are as follows: Five ounces of Paris green and four ounces of London purple. We fill many small paper bags and have them in readiness for the season's work. We take one of the nine ounce bags of combined poisons to one hundred and twenty gallons of water—the amount contained in the supply tank. Before putting the poison in the tank, it is mixed in a small amount of water, to form a paste, and in that way it is thoroughly blended. It is then poured through a fine sieve and strained into the supply tank, which has previously been filled with water. We then take a half gallon of puttycoat of lime, made from best fresh lime, and mix it with water until it is very thin. This is also strained into the supply tank. The straining of the lime water is for the purpose of keeping all grit that is in the lime out of the tank, that would clog the valves and cut the lining of the pump. The lime is added to neutralize the effects of the poison on the foliage of the trees. The poison is ready and spraying commences. The early brood of moths appears about the time of the opening of the apple blossom when the female deposits her eggs in the calyx just as the apple is forming; in a short time the egg hatches and the worm begins its damage. The first spraying to be effective must occur before the calyx of the apple closes and before the egg hatches; otherwise the poison cannot destroy the worm.

The bloom being well off the trees, vigorous spraying with the gasoline spray pump enables us to go over our orchard of one hundred and sixty acres in ten days. Should a rain occur immediately after spraying, we spray again at once. Should we have no rain for the three weeks, we then spray once again; and every three weeks during the season we cover the trees with their coat of poison. Again the gasoline spray pump is a power, in that rapid work is accomplished. In the spring when it is necessary to spray for the first deposits, the period is very short between the falling of the bloom and the closing of the calyx, and it is impossible to thoroughly spray a large orchard with hand pumps.

Then we have the spring rains to combat. If our first spraying has been effective, we do not notice much damage until the broods in August and September appear. The orchard may be sprayed in the spring and early summer, and be free from the worm to the beginning of August, and if neglected for the rest of the year, a great amount of the fruit is destroyed. As a rule our success in spraying has been in *going over the trees for the last spraying the first or second week in September.*

Good returns follow well directed efforts. Four good rules are,
First—Be sure your poison is good.

Second—Thoroughly agitate, as Paris green will settle to the bottom of the tank like sand, and your work is lost.

Third—Apply the poison at the proper time.

Fourth—See that your work is thorough and success is yours.

CONCLUSIONS.

The codling moth is our most serious apple pest.

It is likely to be a serious pest wherever the apple can be successfully grown. Apple-growing regions now free from it are not likely to long remain so.

The average percentage of fruit injured by the codling moth is not greater in Oregon than in other apple-growing regions.

There are but two annual broods—not three or four as has been stated. Owing to irregularity of development these broods overlap so that larvæ may be found in fruit from the time the first wormy apples occur in spring until after the fruit is gathered.

In the Willamette Valley, there appears to be no relation between the blossoming of the apple trees and the time at which the moths appear.

The eggs are deposited principally on the surface of the fruit and not in the calyx. At Corvallis egg-laying does not begin until towards the end of June. It probably does not occur when the evening temperature falls much below 60°, and is probably most active when such temperature is above 75°–80°.

Probably a considerable number of larvæ pupate under clods and rubbish on the ground.

Birds are the most effective natural aids in controlling the codling moth. No benefit is to be expected from the introduction of foreign birds or from artificial use of fungous and bacterial diseases.

Spraying with one of the arsenites is the most practical method of protecting fruit from the codling moth. It is not only practical but necessary to spray for the second brood. Persistent, intelligent spraying should give 85–90 per cent of fruit free from worms. Our best orchardists do even better.

Clean, smooth trees, clean cultivation, sheep or hogs in the orchard, screens over the doors and windows of storerooms, and banding the trees are efficient supplements to spraying.

5000.

Bulletin No. 70.

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OREGON AGRICULTURAL EXPERIMENT STATION,

CORVALLIS, OREGON.

TESTING MILK AND CREAM.

BY F. L. KENT.

The Bulletins of this Station are sent Free to all Residents of
Oregon who request them.

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TESTING MILK.

§ SHORTLY after the introduction of the Babcock Milk Test in 1890, Patrick, then of the Iowa Experiment Station, suggested the use of the composite sample as a means for greatly lessening the labor connected with the testing of milk at creameries and cheese factories, without materially affecting the accuracy of the results. The plan proved popular with the creamery men, and was quite generally adopted by those factories using the Babcock Test.

The composite sample is obtained by first providing a suitable vessel for each patron. This may be either a Mason fruit jar, a lightning top milk bottle, or a wide mouth glass-stoppered bottle of about a pint capacity. This bottle is labeled with the name or number of the patron, and each time he delivers milk, a small portion, an ounce or less, is put into the jar bearing his label. This continues during the test period which may cover a week, ten days, two weeks, or perhaps a month. Most of the factories in this state are in the habit of making two tests each month. The sample is kept from souring by the use of some preservative, most generally bi-chromate of potash; a quantity about the size of a pea being sufficient to preserve the two weeks' sample.

Considerable discussion has been given to the question of the proper manner of sampling the daily deliveries. Three methods are employed, viz: (1) Use of a small tin dipper; (2) the drip sample; and (3) sampling tubes. When all the milk of a day's delivery by a patron is poured into the weigh can and its weight taken it is ready for the sampling. Some operators use a large dipper to stir the milk before taking the sample, but this has been found to be unnecessary, the agitation due to transportation and pouring the milk into the weigh can being sufficient to mix it thoroughly. If the first named method is followed a small tin dipper holding from one-half an ounce to an ounce is used to take a sample from the weigh can. Some of these dippers are made with long handles so that they rest on the bottom of the weigh can when not in use but generally the handle is less than a foot in

length. This method of taking the composite sample is not strictly accurate unless the same amount of milk is delivered each time the sample is taken, or unless the milk should happen to contain the same percentage of butter fat each time. But the variation in amount delivered from day to day is usually so small that the dipper method is sufficiently accurate for all practical purposes.

The drip sample is taken by collecting the milk that drips through a small hole in the conductor spout which conveys the milk from the weigh can to the receiving vat. This method is valuable where it is desired to secure a composite sample of all milk delivered, but it is not well adapted to the sampling of milk of each patron.



a—Milk Thief.
b—Scoville Sampling Tube.

Of the sampling tubes there are several forms but they all work on about the same principle. The two best known probably are the "Milk Thief" and the Scoville Sampling Tube. They both work on the same principle, hence a description of the latter only will be given. "It consists of a brass tube, one-half to one inch in diameter, and two to two and a half feet in length; it is open at both ends, the lower end sliding snugly into a cap provided with three elliptical openings at the side, through which the milk is admitted. The milk to be sampled is poured into a cylindrical pail, or the factory weigh can, and the tube with the cap set so that the apertures are left open, is lowered into the milk until it touches the bottom of the can.

The tube will be filled instantly to the level of the milk in the can, and is then pushed down, thereby closing the apertures of the cap and confining within the tube a column of milk representing exactly the quality of the milk in the can, and forming an aliquot part thereof. The milk is then emptied into the composite sample jar by turning the tube upside down."

In order to make a comparison between the dipper and the sampling tube methods, also to compare the results of the composite sample with the results obtained by daily tests, and incidentally to notice the variation in daily tests, the writer conducted a series of tests at the creamery in Corvallis during the first half of the month of May, 1901. The creamery operator was using the dipper method and took his samples as usual during the two weeks. Whenever he

placed a sample in a composite jar, the writer put a sample of the same milk in a corresponding jar, the latter sample being taken with a Scoville sampling tube. At the close of the test period both sets of composite samples were carefully tested and the results compared. In most cases the composite jars contained thirteen samples, the test period covering fifteen days, two of them being Sundays, on which no milk was received at the creamery.

Whenever a sample was placed in the composite jar, another sample, also taken with the Scoville sampler, was tested at once, and the average of these daily samples was compared with the test of the composite sample at the close of the test period. The milk of fifty two patrons was used in this work, the daily deliveries per patron ranging from fifteen pounds to four hundred fifty pounds. A record was kept of the number of pounds of milk from which each test was taken, and the amount of fat in each delivery was obtained by multiplying the number of pounds by the percentage of fat which the test indicated was present. The average of the daily tests was thus obtainable by two methods, viz: (1) By dividing the sum of any one patron's tests by the number of tests; (2) by dividing the total amount of fat delivered by the total amount of milk. These two averages were very nearly alike, in many cases being identical as will be seen by reference to Table I. Where a difference exists it is due to a variation in the amount of milk delivered from day to day. For instance: Suppose two deliveries were made, one of 325 pounds testing 3.6 per cent, and one of 430 pounds testing 3.9 per cent. The average of the two tests would be 3.75 per cent, but the average per cent obtained by dividing the total amount of fat by the total pounds of milk $[(11.70 + 16.27) \div 755]$ would be 3.77 per cent.

Table No. 1 is designed to show for the test period of a half month the following for each patron: (1) the total number of pounds of milk delivered; (2) the average of the daily tests; (3) the average test computed by dividing the total fat by the total amount of milk; (4) the composite test obtained by the use of the Scoville sampling tube; (5) the test of the composite sample taken by the creamery operator with the little tin dipper.

TABLE I.

NUMBER.	Lbs. Milk	Av. of tests	Tests from total fat	Composite	Creamery composite
		Per ct.	Per ct.	Per ct.	Per ct.
1	5912	3.86	3.86	3.85	3.90
2	964	4.16	4.18	4.15	4.10
3	3702	3.75	3.75	3.80	3.60
4	2430	3.98	3.96	4.10	3.85
5	4284	3.85	3.84	3.80	4.00
6	601	4.01	4.01	4.05	3.80
7	527	3.40	3.39	3.40	3.25
8	2595	3.62	3.62	3.50	3.50
9	459	3.89	3.88	4.00	3.80
10	1157	3.96	3.93	4.00	3.90
11	1317	3.60	3.59	3.60	3.45
12	1441	3.89	3.89	3.95	3.85
13	2618	3.69	3.72	3.75	3.65
14	1792	4.04	4.04	4.00	3.85
15	1981	4.60	4.59	4.45	4.50
16	2160	4.71	4.72	4.75	4.60
17	2970	3.84	3.85	3.90	3.90
18	912	4.36	4.36	4.25	4.40
19	301	3.33	3.34	3.30	3.20
20	825	3.81	3.79	3.85	3.75
21	1364	3.74	3.74	3.60	3.55
22	963	3.64	3.64	3.55	3.40
23	2571	3.73	3.72	3.85	3.80
24	213	4.78	4.79	4.85	4.80
25	746	3.76	3.73	3.60	3.60
26	571	4.14	4.15	4.00	4.20
27	1345	3.93	3.92	3.95	4.00
28	613	3.94	3.95	4.00	4.00
29	955	4.67	4.63	4.70	4.65
30	472	3.77	3.74	3.75	3.75
31	1161	4.04	4.05	4.00	4.10
32	307	4.35	4.38	4.40	4.20
33	736	3.45	3.47	3.50	3.35
34	864	4.28	4.27	4.20	4.35
35	907	3.49	3.48	3.50	3.50
36	990	3.83	3.85	3.80	3.70
37	2041	3.61	3.61	3.70	3.70
38	739	4.51	4.50	4.40	4.40
39	1550	4.24	4.24	4.20	4.00
40	868	3.61	3.63	3.60	3.65
41	503	3.72	3.68	3.80	3.85
42	949	4.20	4.18	4.05	4.05
43	951	4.58	4.58	4.60	4.40
44	572	3.48	3.50	3.50	3.35
45	518	5.06	5.03	5.00	4.80
46	236	4.81	4.81	4.85	4.85
47	801	5.03	5.02	5.00	5.00
48	470	4.20	4.18	4.20	4.10
49	647	3.47	3.46	3.40	3.40
50	669	3.61	3.61	3.60	3.60
51	243	4.40	4.41	4.40	4.30
52	428	4.08	4.08	4.15	3.95
Average		4.01	4.01	4.00	3.95

By reference to table I it will be seen that in no case is there a difference of more than .04 between the two methods of computing the average of the daily tests, notwithstanding the fact that there was, in many cases, a wide variation in the daily tests, as will be shown in table II.

While there are a few cases in the foregoing table where a difference of more than .1 of one per cent exists between the results ob-

tained by the average of the daily tests and the composite sample test taken with the Scoville sampling tube, on an average this difference amounts to but .01 of one per cent.

When a comparison is made between the composite samples taken with the sampling tube and those taken by the little dipper method, it will be seen that in a few instances there is as great a difference as .2 of one per cent in the readings. But on the average the difference amounts to but .05 of one per cent, which difference can hardly be considered as being important in commercial work. The fact that the creamery composite samples were warmed to about 100° F. before measuring, while the others were measured at about 70° may partially account for the lower average test of the former.

Table II is a record of the daily tests of twenty of the fifty two patrons furnishing milk during the experiment. The first half of the table shows the tests of the ten patrons furnishing the largest amounts of milk, while the latter half shows tests of patrons delivering less than 100 pounds daily. They are thus arranged for the reason that we would naturally expect less variation where the milk came from a considerable number of cows than where only a few animals were kept, and the table shows that such is the case.

TABLE II.
Showing Variation in Daily Tests.

	Date	1	2	3	4	6	7	8	9	10	11	13	14	15	Av. test	Variation	Av. milk
No	1	3.8	4.1	4.0	4.0	3.9	3.9	4.0	3.8	3.8	3.9	3.8	3.6	3.7	3.86	.5	455lbs.
	3	3.9	3.8	3.8	3.9	4.0	3.7	3.7	3.6	3.8	3.6	3.6	3.8	3.6	3.75	.4	285
	4	3.9	4.1	4.2	4.2	3.9	4.0	4.0	4.0	4.0	4.0	3.8	3.9	3.8	3.98	.3	187
	5	4.1	4.1	3.8	3.9	3.7	4.0	3.7	3.4	3.9	3.8	3.6	4.2	3.9	3.85	.8	338
	8	3.4		3.8	3.8	3.5	3.6	3.6	3.6	3.8	3.5	3.8	3.4	3.6	3.62	.4	200
	13	3.8	3.9	3.8	3.5	4.0	3.5	3.6	3.6	3.4	3.8	4.2	3.5	3.4	3.69	.8	201
	14	4.0	4.0	4.0	4.2	4.1	4.2	4.0	4.1	4.1	4.0	4.0	3.9	4.0	4.04	.3	138
	15	4.6	4.7	4.5	4.6	4.6	4.6	4.6	4.7	4.5	4.8	4.4	4.6	4.6	4.60	.4	148
	16	4.8	4.5	4.8	4.5	4.8	4.5	5.0	5.0	4.4	4.5	5.0	4.4	5.0	4.71	.6	166
	17	3.9	4.0	4.1	3.9	4.2	3.8	3.9	3.8	3.6	3.8	4.0	3.4	3.6	3.84	.8	228
	2	3.9	4.2	4.2	4.4	4.6	4.0	4.1	3.8	4.0	4.6	4.0	4.5	4.0	4.16	.8	74
	7	3.7	3.4	3.4	3.4	3.1	3.5	3.6	3.0	3.4	3.7	3.3	3.4	3.3	3.40	.7	42
	10	4.0	3.9	4.0	3.6	3.6	3.8	3.6	3.7	5.1	4.0	3.6	5.1	3.6	3.96	1.5	89
	31	3.8	4.2	4.0	3.8	4.1	4.0	4.0	3.9	4.6	4.0	4.1	4.1	4.0	4.04	.8	89
	33	3.6	3.4	3.2	3.5	3.6	3.1	3.3	3.7	3.2	3.8	3.7	3.6	3.2	3.45	.7	56
	34	4.5	4.4	4.2	4.3	3.9	4.5	4.4	4.4	4.4	4.1	3.9	4.3	4.3	4.28	.6	66
	35	3.4	3.2	3.3	3.8	4.1	3.2	3.2	3.5	3.4	3.7	3.6	3.2	3.8	3.49	.9	70
	38	4.4	3.8	5.3	4.6	4.9	4.6	4.5	4.7	4.9	4.2	4.0	4.5	4.2	4.51	1.3	61
	45	4.7	4.8	4.8	5.2	5.3	5.1	4.9	5.1	6.0	5.4	4.8	5.1	4.5	5.06	1.5	40
	47	5.0	5.1	5.0	5.6	5.0	4.6	5.4	5.0	5.0	4.8	4.7	4.8	5.5	5.03	1.0	23

Reference to table II shows a variation in the tests of the first half the table ranging from .3 to .8 during the two weeks covered by the test period, the average being .52. In the latter half of the

table the variation ranges from .6 to 1.5 per cent, the average being .98. It was known that some of the patrons whose tests appear in the latter part of the table occasionally did not send all their milk owing to lack of can capacity, but added cream from that which was retained to the milk sent to the factory. This doubtless accounts for the high tests, and the removal of a portion of the cream, when household necessity required it, probably accounts for most of the low tests.

Failure to get a clear fat column is probably the greatest difficulty encountered by Babcock test operators. This trouble usually comes from one or more of three sources:

First. Water containing foreign substances, usually carbonates, which upon addition to the test bottles causes the formation of gas bubbles at the top of the fat column. Remedy: Use rain or distilled water.

Second. Acid of improper strength. If the acid is too strong the fat column will present a charred or burned appearance, sometimes throughout its entire length, but usually in the lower part. If the acid is too weak there will be a cloudiness of the fat column, often with a grayish white substance at the lower end. In the first case the trouble, if not very bad, can be remedied by using a little less than the usual amount of acid. In the second case the use of a little more than the usual 17.5 c c of acid will generally produce desirable results. Satisfactory results can not be secured, however, if the acid is very far from the proper strength, which is acid having a specific gravity of 1.82 to 1.83, or as it is sometimes expressed, 90 to 92 per cent.

Third. An unfavorable temperature. Too high and too low temperatures of the milk and acid at the time of adding the latter, produce respectively, conditions similar to those existing when the acid is too strong or too weak. The proper temperature is between 60° and 70° F., which can be easily obtained by setting the measured sample in the test bottles in cold water or warm water as the case may require, also placing the acid bottle where it will come to the desired temperature before using.



Babcock Test Apparatus Showing Cream Scales.

PART II.

CREAM TESTING.

The growing popularity of the hand separator makes the testing of cream of more importance than the testing of milk in some localities. In fact there are several creameries in the state which receive no milk, and some that formerly handled milk only, are now receiving a large portion of their butter fat in the form of hand separator cream. The universal use of the Babcock test in the Oregon creameries has prevented the employment of any other means of determining the percentage of butter fat in cream, while in some of the older dairy states the old oil test churn which was in use in the days of the gathered cream system before the introduction of centrifugal separators, has come into use again in the testing of hand separator cream. The creamery operator who has fully mastered the use of the Babcock test as applied to milk, finds new questions arising when he comes to use the same method for testing cream. Among these questions the following are perhaps the most important: How should sampling be done? Can the composite method be followed? Does the 17.6 c.c. pipette give an accurate test sample? With a view to obtaining information on these points the writer spent over a month among three of the creameries located in Portland, making several hundred tests during that time, the results of which will be found in the following pages.

Sampling the Cream.

Cream is seldom poured into a weigh-can at the factory as milk is, but is weighed in the can in which it is transported. This difference in handling, with its greater viscosity, makes fair sampling more difficult than with milk. The Scoville tube, so valuable as a milk sampler, is not well adapted to sampling cream, unless it be a very thin sweet cream. But the milk thief can be used to very good advantage. However, it is advisable to stir the cream with a long handled dipper before taking the sample with the milk thief. The taking of the sample with the dipper is not to be recommended, particularly if the composite sample is used, because it will not give a proportionate amount in the quantity taken each time for the sample, and further, the contents of the can will probably not be thoroughly mixed by the stirring that will ordinarily be given. Out of 100 comparative tests (200 tests made) of samples taken by the

dipper and the thief methods, 58 were alike, 3 were higher, taken with the thief, and 39 were higher taken with the dipper, the variation ranging from 0.5 to 2.0 per cent. The samples were taken by first stirring the cream with a dipper holding about a half pint; then two or three times as much cream as would be required for a test was poured from the dipper into a sample jar. At the same time the thief was lowered into the can and the sample thus obtained placed in another sample jar. It is probable that the large number of higher tests with the dipper samples was due to the cream not being thoroughly mixed, and when a portion of the contents of the dipper was transferred to the sample jar it was composed of cream containing above the average percentage of butter fat for the contents of the can. The variations were fewer and smaller in size when the cream was sweet than in the case of sour samples.

Where the cream is collected from the farms where it is produced, by cream wagons, the method of sampling suggested in Bulletin 108 Conn. Exp. Sta., is to be recommended. The method, briefly, is as follows:

"The cream gatherer is provided with a spring balance for weighing, a pail for holding the cream while weighing, small wide necked bottles with numbers on the corks corresponding to the patron's numbers, and with a sampling tube. The cream is emptied into the pail, weighed, and after being poured two or three times from one vessel to another, a sample is taken and put into the bottle having the patron's number. When the driver returns to the creamery, the samples of cream in the wide necked bottles are emptied into a pint jar bearing the patron's number and containing some preservative. This gives a composite sample which may be tested as often as desired, at least once in two weeks."

Measuring the Test Sample.

The Babcock test is based on the assumption that 18 grams (or a fractional part thereof) of the substance to be tested will be placed in the test bottles. In sampling milk the 17.6 c.c. pipette will deliver the required 18 grams, but in testing cream the same pipette delivers less than 18 grams, and the higher the percentage of fat in the cream the greater will be the deficiency in the amount delivered. As the percentage of fat in cream increases, its specific gravity decreases, or in other words, it becomes lighter for the same volume.

The following table shows the specific gravity of cream containing different percentages of fat, also the amount by volume required to weigh 18 grams, as computed from the specific gravity:

TABLE III.

Per cent fat.	Specific gravity.*	Volume required to weigh 18 grams.
10	1.028	17.60 c.c.
15	1.012	17.79
20	1.008	17.86
25	1.002	17.96
30	.996	18.07
35	.990	18.36
40	.986	18.63
45	.950	18.95
50	.947	19.01

* Farrington and Woll. "Testing Milk and its Products."

While the figures in the last column of the above table doubtless are correct for sweet cream, they are too low for cream that has become sour, thus containing more or less gas bubbles, or even for sweet cream that has been vigorously agitated and therefore containing more or less air bubbles.

Weighing Cream Samples.

Uniformly accurate results in testing cream can be obtained only by weighing the sample to be tested. For this purpose there is probably nothing better than the Trohmer Cream Scale, shown at the left of the illustration opposite page 169. This scale is moderate in price, very durable as it has crystal bearings, and porcelain pans, and is very sensitive. For rapid work a bottle should be placed on each scale pan. Then the bottles are balanced by means of the sliding poises at the front of the scale. Next place the 18 gram weight on the right hand scale pan beside the bottle, and with a pipette run cream into the left hand bottle until the scales again balance, as shown in the illustration. Now remove the 18 gram weight and run cream into the bottle on the right hand scale pan until the scales are again in balance. Two samples can thus be weighed with one adjustment of the poises which effects a considerable saving of time. By following this method, twenty-four samples can easily be weighed out in an hour. The 9 gram weight is often used instead of the 18 gram, and the only objection to its use is that the readings obtained must be multiplied by 2, thus doubling any error in reading. But there are many points in favor of the practice. Only one-half the amount of both cream and acid is required which in time amounts to quite a considerable saving; the mixing can be done more quickly, and there is more room for the addition

of hot water, which is desirable where a hand whirling machine is used; and since cream bottles are commonly made to read not higher than 25 to 30 per cent, if the 9 gram plan is followed the richest sample one is liable to get can be tested in the usual manner.

The following table is designed to show the difference in readings obtained by measuring the sample with the 17.6 c.c. pipette, and by weighing it with the cream scales. The 17.6 c.c. pipette was rinsed with about 6 c.c. of warm water after measuring each sample, and the rinsings put into the test bottle, in order that the pipette should deliver its full capacity. The amount of cream adhering to the inner surface of the pipette varies greatly with the condition and fat content of the cream. If the cream is sweet and rather thin the amount left in the pipette will not make a difference of more than .2 or .3 of one per cent in the reading of the test, but when the cream is very thick by reason of containing 30 to 40 per cent of butter fat and also being sour, the error may amount to 3 or 4 per cent.

TABLE IV.

Number of trials.	Test with 17.6 c.c. pipette.	Av. test with 18 grams.	Variations.
3	13.5 per cent.	14.7 per cent.	14.5—15.0 per cent.
4	14.0	15.0	None.
3	14.5	15.3	15.0—16.0
3	15.0	16.0	None.
8	15.5	16.8	16.5—17.0
4	16.0	17.1	17.0—17.5
7	16.5	17.8	17.0—18.0
7	17.0	18.1	17.5—18.5
9	17.5	18.5	18.0—19.0
16	18.0	19.1	18.5—19.5
15	18.5	19.7	19.0—20.0
9	19.0	20.0	None.
15	19.5	20.7	20.0—21.0
20	20.0	21.1	21.0—21.5
11	20.5	21.7	21.5—22.0
21	21.0	22.4	22.0—23.5
10	21.5	23.0	22.5—24.0
17	22.0	23.2	22.5—24.0
17	22.5	23.7	23.0—24.0
13	23.0	24.2	24.0—25.0
10	23.5	24.9	24.5—26.0
15	24.0	25.2	25.0—26.0
13	24.5	26.0	25.5—26.5
10	25.0	26.6	26.0—28.0
4	25.5	27.2	27.0—28.5
8	26.0	27.5	27.0—28.0
6	26.5	27.7	27.0—28.0
17	27.0	28.6	28.0—30.0
7	27.5	28.9	28.5—29.0
5	28.0	29.7	29.0—30.0
6	28.5	30.5	30.0—31.0
2	29.0	30.8	30.5—31.0
5	29.5	31.4	31.0—32.5
2	30.0	32.0	None.
2	31.0	34.0	None.
2	32.5	35.0	None.
5	34.0	36.7	36.0—37.5
2	37.0	42.0	40.0—44.0
2	38.0	41.0	None.

The tests in the foregoing table were all made under factory conditions from samples taken from the daily shipments received by two Portland creameries. All weighed samples for testing were also measured with a pipette graduated to tenths of a cubic centimeter and it was found that, when the cream was sweet and contained from 18 to 25 per cent fat, there was but a small variation in the amount required to weigh 18 grams, the variations ordinarily ranging between 18.0 and 18.4 c.c. But for cream of the same fat content that had become nearly or quite sour enough for churning, the amount required to weigh 18 grams frequently exceeded 19.5 c.c. while creams testing over 30 per cent sometimes required, when sour, more than 20.5 c.c. to weigh the required 18 grams. The range of variation in tests recorded in the last column of Table IV, is due to this difference in the condition of the cream. Some samples were perfectly sweet while others were exceedingly sour. In every case the greatest difference between the test made by measure and by weight occurred when the cream was very sour.

The results obtained indicate that practically accurate tests can be secured, when the cream is sweet and contains not more than 25 per cent butter fat, by using a pipette of 18 c.c. capacity for measuring the sample. But if the cream is sour or contains more than 25 per cent fat, such measuring can not be relied upon and for accurate results weighing the sample must be practiced. It should be borne in mind that the bottles commonly used in testing cream are so graduated that operators do not attempt to make readings closer than .5 of one per cent as a rule, and some practice recording their tests only in the nearest whole per cent.

The following are a few of the tests made, showing amount required to weigh 18 grams.

TABLE V.

Test 17.6 c.c.	Test 18 grams.	Volume required to weigh 18 grams.	Condition of sample.
18.0 per cent.	19.0 per cent.	18.2 c.c.	Sweet.
18.0	19.5	19.4	Sour.
20.0	21.0	18.2	Sweet.
20.0	21.5	19.6	Sour.
23.0	24.0	18.2	Sweet.
23.0	25.0	20.0	Sour.
25.0	26.0	18.4	Sweet.
25.0	28.0	20.2	Sour.
30.0	31.0	18.5	Sweet.
31.	34.0	20.0	Sour.

NOTE.—The acidity of the sour samples was about .6 per cent.

Composite Sampling.

The adaptability of the composite sample to the testing of cream was a subject for investigation the results of which are found in the following table:

TABLE VI.

Patron No.	Lbs. Cream.	Test from total fat.	Average of daily tests.	Composite.
1	1046	25.17	25.75	25.75
2	581	26.26	26.25	26.25
3	686	22.85	22.55	22.00
4	690	22.00	21.75	21.75
5	1339	25.15	25.55	25.25
6	1362	24.69	25.15	25.00
7	157	32.00	32.00	32.00
8	112	37.60	37.35	37.50
9	85	41.20	41.00	41.50
10	209	22.76	22.83	23.00
11	1123	20.21	20.25	20.00
12	978	22.87	23.00	22.50
13	202	24.36	24.37	24.00
14	1244	18.28	18.31	18.00
15	193	22.42	22.50	22.50
16	689	25.43	25.57	25.00
17	793	20.80	21.00	21.00
18	513	27.16	27.00	27.60
19	731	20.44	20.50	21.00
20	541	16.25	16.33	16.50
21	240	17.60	17.60	18.00
22	805	25.47	25.87	25.00
23	1241	21.51	21.62	21.50
24	862	23.55	23.50	23.50
25	490	15.00	15.00	15.00
26	561	29.50	29.63	29.00
27	515	22.21	22.21	21.50
28	780	22.70	22.20	22.00
29	866	24.16	24.14	24.00
30	747	20.67	20.35	20.00
31	422	28.35	28.75	28.50
32	1019	21.43	21.71	21.50
33	513	36.60	36.85	37.00
34	1641	28.55	28.53	28.50
35	334	28.90	28.75	28.50
36	214	28.70	29.00	28.50
37	1422	28.12	28.35	28.00
38	1113	19.02	19.27	19.00
39	379	22.50	22.50	23.00
40	100	23.30	23.50	23.00
41	214	23.98	24.00	24.00
42	226	26.00	26.00	25.00
43	240	17.34	17.42	18.00
44	529	23.77	23.77	24.00
45	319	42.54	43.00	44.00
46	382	41.10	41.66	41.00
47	1214	27.55	27.58	28.00
48	1322	29.44	29.54	29.50
49	1791	19.52	19.50	19.00
50	496	31.79	31.43	31.50
Averages		25.37	25.42	25.34

Nos. 1 to 9 were secured from the Hazlewood Cream Co., and are the results of a ten days' composite test period, July 20-30. The samples were practically all sweet when placed in the composite jar, and were in excellent condition when the composite test was made.

Nos. 10 to 32 are the results of daily tests of the regular shipments, with a few exceptions, received by the Weatherly Creamery Co., and also cover a test period of ten days, Aug. 1-10. About one-half of these composite samples were made up from daily samples of sweet cream, the other half being from deliveries that were always sour. Satisfactory tests were obtained from each of these composite samples.

Nos. 33 to 50 represent the results of two composite test periods of fifteen days each, July 2-16, and July 17-31, the samples being taken from the regular shipments received by the Townsend Creamery Co. With the exception of Nos. 34, 38, 44, and 49, these samples were always sour when received. However, but three composite samples were in bad condition at the close of the test period.

It will be observed from the averages in table VI that the composite sample test is more nearly correct than the average of the daily tests, that is, it comes nearer being equal to the "test from total fat," which was obtained in the manner explained in the introduction to table I.

It will also be observed that in only one instance, No. 45, is there a difference between the composite test and the test from total fat, exceeding 1.00 per cent, and only comparatively few in which there is a difference greater than .5 per cent, while the average of the fifty comparisons shows a difference of but .03 per cent. This is really a less variation than was found in milk samples according to Table I if the relative fat content of milk and cream is considered.

It should be borne in mind that the test bottles used in making these cream tests were of the form most commonly used for that purpose viz., straight, wide-necked bottles, graduated to 30 per cent, the subdivisions of the scale representing .5 per cent so that readings closer than .5 per cent would be only approximations.

TABLE VII.

Patron No.	1	2	3	4	5	6	7	Variation.
1	20.5	27.0	26.0	25.0	27.0	28.0	27.0	7.5 %
6	31.0	28.0	24.5	23.0	22.0	24.0	23.5	9.0
11	23.0	20.0	20.5	19.5	20.0	19.0	20.0	4.0
20	15.0	14.5	18.5	18.5	14.5	17.0		4.0
22	27.0	25.0	23.0	30.5	26.0	24.0	25.5	7.5
23	28.0	25.0	23.0	22.5	22.0	19.0	20.0	9.0
23	38.0	41.0	37.0	37.0	35.0	33.0		8.0
26	18.0	18.5	19.0	18.5	19.5	21.0	20.0	3.0
30	22.0	22.5	22.5	22.0	23.0	23.0		1.0
49	20.0	19.0	21.0	19.5	20.0	18.5	18.5	2.5

Table VII shows variations in daily tests. It is composed of successive tests of a portion of the deliveries from which the averages were made in table VI. It will be noticed that the least variation occurred with patron No. 39, and amounted to only 1.0 per cent, while patrons No. 6 and No. 28 showed a variation of 9.0 per cent.

SUMMARY.

The milk thief or some similar appliance should be used in preference to the little dipper method in taking cream test samples.

For all practical purposes, a pipette holding 18 c.c. can be used in measuring test samples of sweet cream containing between 18 and 25 per cent fat. If the cream is sour or contains more than 25 per cent fat, the test sample should be weighed.

Considerable variation will be found in the tests of daily deliveries during a composite test period. A variation of 9.0 per cent or more may be expected.

The composite sample can be applied to the testing of cream quite as successfully as in milk testing. Fifty comparisons of composite tests with "tests from total fat" showed an average difference of but .03 of one per cent.

Composite test periods for cream should not exceed ten days in hot weather. At other seasons of the year semi-monthly periods will prove satisfactory.

5000.

Bulletin No. 71.

June, 1902.

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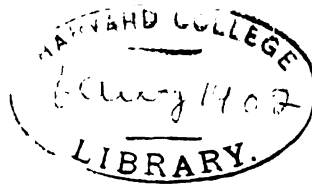
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STAGNANT WATER GERMS IN MILK.

In the Willamette valley, as well as elsewhere, there are many places where cattle, during the summer and fall, can obtain their drinking water from sloughs and stagnant ponds only. As sickness, especially typhoid fever, prevails in some of these localities, an investigation as to whether the germs commonly found in such water find their way into the milk supply through the cow or not, has been a subject of experiment with the following results:

On the 26th of March, 1902, a cow from the experiment station herd was placed in a stall and fed with a ration consisting of 8 pounds of oil meal, 30 pounds of cut clover ensilage and about 10 pounds of mixed hay. To the first drinking water in the morning was added ten c. c. of a pure culture of *fluorescens liquefaciens*, grown in Dunham's solution. The culture was added to about a half bucket of water, which the cow drank readily, after which she was allowed to go out with the other cows and drink whatever additional amount of water she chose. A sample of milk was taken night and morning in sterilized tubes and plate cultures were made on agar by flowing the milk over the surface of the agar and allowing the surplus to drain off; by this means the media kept semi-transparent, and the colonies occurred on the surface only, where they could readily be examined and studied.

Bacillus fluorescens liquefaciens is a non-pathogenic germ commonly found in water and widely distributed. Before administering the culture to the cow it was grown in the incubator until by close estimate, there were 50,000 germs given to the cow each day. For ten days this culture was fed to the cow and plate cultures made from the milk morning and evening without developing one colony of these germs. After inoculating the plates they were incubated for twenty-four hours at 37° C.; then they were allowed to remain at the room temperature until growth of colonies had entirely ceased. Examinations of the plate cultures were made twice daily so that no colonies should escape detection.

On the 5th of April the culture was changed to *bacillus janthinus* and administered to the cow for ten days in the same manner as *bacillus fluorescens liquifacien* was. Plate cultures were made from the morning and evening milk, but not one single colony of these germs developed on the plates. *Bacillus janthinus* is also a harmless germ found in water, frequently in sewage. When grown

in artificial media it forms a violet colored pigment and is easily detected.

On the 15th of April the culture was again changed to bacillus ramosus and administered to the cow in the same manner as the two previous cultures were, for ten days. Plate cultures were made from the milk twice each day with negative results. Cultures were also made from the urine and excreta but failed to develop any colonies of ramosus. Bacillus ramosus is another harmless, common, widely distributed germ, found in the soil and water. It is very active in decomposing roots and vegetable matter, forms spores quite freely and for this reason was selected. The cultures were allowed to form spores in abundance before administering to the cow. As spores have so much greater resisting power than germs, they were used in this case to ascertain if they would withstand the action of the digestive fluids of the cow and find their way into the milk.

On the 30th of April the cow was removed to special quarters, preparatory to administering pure cultures of typhi abdominalis. A record of her temperature was taken twice daily for seven days and, was as follows:

	Morning Temperature.	Evening Temperature.
April 30.....	102 ° F	101.8° F.
May 1.....	101.8	101.8
May 2.....	102	101.8
May 3.....	101.8	101.8
May 4.....	101.4	101.8
May 5.....	101.4	101.4
May 6.....	101.4	101.2

On the 7th of May there was administered to the cow, with the drinking water, ten c.c. bouillon culture of typhi abdominalis which had been growing in the incubator for eight days previous. Each day after this date the same amount of culture was given for ten days, after which time the amount was increased to twenty c.c. and continued for five days more.

Agar and gelatine plate cultures were made from the milk night and morning but only two colonies of typhoid developed. These must have been accidental inoculations. Each plate throughout the experiment contained more or less colonies resembling the germs given the cow, which necessitated their being classified so as to avoid any possible error. This required an immense number of sub-cultures and much laboratory work, because there are many other germs whose morphological and cultural characteristics are similar to the typhoid bacillus. The other germs used were easily identified and did not require the time and labor to ascertain if they were present.

During the time that the cow was being fed with the typhoid cultures, examinations and cultures were made of the excreta and urine, but no colonies of this germ could be induced to grow although all the modern methods and different culture medias were employed.

The cultures of typhi abdominalis seemed to have no effect upon the health of the cow as the following record of her temperature indicates:

Date.	Morning Temp.	Evening Temp.
May 7	101.4 F.	101.8° F.
8	101.4	101.6
9	101.6	101.6
10	101.6	101.4
11	101.4	101.6
12	101.4	101.6
13	101.4	101.4
14	101.4	101.4
15	102.4	101.6
16	101.4	101.6
17	101.4	101.4
18	101.2	101.6
19	101.4	101.6
20	101.4	101.8
21	101.6	101.8
22	101.6	101.8
23	101.4	101.4
24	101.2	101.4
25	101.2	101.6
26	101.2	101.4
27	101.4	101.8
28	101.2	101.6
29	101.2	101.6
30	101.4	101.8
31	101.2	101.0
June 1	101.4	101.8
2	101.2	101.6
3	101.4	101.8
4	101.2	102.0
5	101.4	101.8
6	101.2	102.0
7	101.4	101.8
8	101.4	102.2

In order to determine whether or not the typhoid bacilli would enter the cow's udder through the teat, by the cow's wading in stagnant water that contained this germ, the same cow that had been used throughout the experiment was allowed to rest for several days without receiving any cultures; then a pure culture of typhoid bacilli was prepared and twenty c.c. was added to fifty c.c. of water in a large mouth bottle. Directly after milking and before the teats had become dry at their extremities they were inserted in the bottle, thoroughly wetting them with the culture, and then allowed to dry spontaneously. Twelve hours after and just before milking, each teat was thoroughly disinfected with a strong solution of corrosive sublimate. After drying the teats about one c.c. was milked into sterile test tubes from each teat under aseptic precautions. This operation was repeated morning and evening for five days and plate

cultures were made from each sample but *no colonies of typhoid appeared*, which was contrary to expectations.

The cow used in this work was a Jersey about four years old, with fair shaped udder, good teats of medium size, reasonably easy to milk, and a fair subject for the experiment. She was strictly quarantined and every precaution observed to prevent any possibility of spreading the germs. All the milk not needed for the laboratory was boiled and fed to hogs.

In order to be sure that the milk was safe to use after the experiment was finished, plate cultures were made from time to time for a number of days without developing any colonies of typhoid bacilli.

It is evident that outbreaks of typhoid fever occur, which, if the cause was carefully traced, would be found to come not from the milk as it leaves the cow, but from vessels which had been washed with contaminated water.

Since the advent of the cream separator, which is usually driven by steam power, steam has been used to clean all the utensils in the dairy. Not only is it efficient for this purpose but as a germ destroyer there is nothing better, because it penetrates to the bottom of the seams and heats the metal to such a degree as to kill dangerous germs.

The results obtained by this investigation are gratifying, inasmuch as that they are conclusive: First, that a pure culture of typhoid bacilli mixed with water and given to the cow to drink did not pass into the milk; second, that they did not pass from the cow alive with the excreta; third, that they did not pass from the cow alive with the urine; and fourth, that they were not taken into the udder by capillary attraction, through the teat orifice.

There is no doubt that there is a great variation in the teats of different milk cows. A teat possessing weak sphincter muscles is imperfectly closed at its extremity and must necessarily be more accessible for bacteria to enter through the duct and invade the contents of the udder, while another teat having good muscular contracting power would be less likely to admit germs. Yet it seems almost impossible that any moist muscular orifice could so contract as to shut out an organism of such minute dimensions, especially those like typhoid which are actively motile.

It is generally believed that micro-organisms gain access to the milk in the cow's udder through the teat but in this case they did not, although the result might not be the same with all cows.

If, upon the other hand, germs should enter the cow's udder so readily, multiplying there (which they surely would under such favorable conditions) and living germs also pass through the cow in the excreta, the danger from typhoid fever at a time when cows drink concentrated stagnant water would be very great, and the germs would be scattered so generally that epidemics of the disease would prevail to a greater extent than they do. It is true that stagnant water does not always contain typhoid fever germs yet it is a very likely place to find them.

Although the results in this experiment have been negative in transmitting the germs from polluted water to the milk supply through the cow, it does not follow that the danger from cows using such water does not exist. All cows may not have the power of filtering out or rendering the germ inert, and continuous use of such water for a great length of time might give far different results.

There are many things going on in the living animal body that are not fully understood. During the time that a cow is drinking stagnant water, if she becomes sick or diseased from any cause, it is difficult to tell how the ailment may affect the mammary glands or milk secretion. It would certainly be far better that she be not allowed to have any other water to drink than the purest obtainable at all times. Sloughs and stagnant water ponds in pastures should be fenced off so as not to allow the cow to drink unwholesome water.

A pond of stagnant water contains an immense number of germs which during the warm weather multiply rapidly; as they are at that time in an active condition of life they must feed upon something in the water. If they live and feed they must also secrete. Their secretions are chemicals and compounds not found in pure water. Therefore a water charged with these germ products is often unwholesome both to the animal and to the human body. A material in which germs have grown for a long time becomes impregnated with their secretions and although it be freed from germs by boiling, or any other means, the chemicals, poisonous or not, still remain in the liquid. Whether or not water in such a condition enters the milk chemically unchanged, is a subject for chemical analysis and is not within the province of this article.

The number of germs administered to the cow each day was small compared with the number which would be contained in the amount of stagnant water that she might drink; nevertheless a

sufficient amount was given her to demonstrate that nature has provided some means of preventing germs from entering the milk through the secretions. Just what becomes of the tremendous number of germs that a cow drinks with impure water is a subject for further investigation.

Milk cows which are allowed to have access to stagnant water ponds during the summer will invariably wade in the water to escape from flies and to cool themselves. Not infrequently are they seen in water of sufficient depth to reach to their stomachs. In so doing their udders and teats are submerged for variable lengths of time. If the water contains organisms detrimental to milk, contamination is sure to follow as it is impossible to milk a cow without particles of material falling into the milk and carrying with it innumerable germs. This we know occurs to such an extent that it is customary to strain the milk to remove the particles of foreign matter. When a bacteriological study is made of this sediment the number and kinds of these germs found are truly surprising. If all the germs thus entering the milk would remain in the sediment it would be all right, but unfortunately, dropping into the milk with this foreign matter, the germs are liberated through constant agitation incident to milking. As warm milk is a very suitable material for germs to grow in, especially typhoid fever germs, the number which would multiply in twelve hours from the few introduced at the time of milking, would be enormous and dangerous. As it is not customary to cleanse the cow before milking, it would at least seem advisable to prevent the animal from having access to foul water. Milk is one of the articles of food which is subject to more invisible impurities than any other, and it is administered to delicate infants in its raw condition, frequently giving rise to disorders which might be averted.

ACKNOWLEDGMENTS.

I must express my thanks to Dr. Withycombe, Director of the Station, for kindly furnishing the cow for the experiment, and also to Mr. W. J. Kent, foreman of the farm and to Mr. Cady, who has charge of the cows, for their valuable assistance in administering the cultures to the cow, and obtaining samples of milk.

5000.

Bulletin No. 72.

June, 1902.

OREGON AGRICULTURAL EXPERIMENT STATION,
CORVALLIS, OREGON.



Preliminary Report on Steamed Silage.

JAS. WITHYCOMBE.

A. L. KNISELY.

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Geo. B. Keady, Printer.
1902.

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F. E. Edwards, B. M. E.....	<i>Chemistry.</i>

PRELIMINARY REPORT ON STEAMED SILAGE.

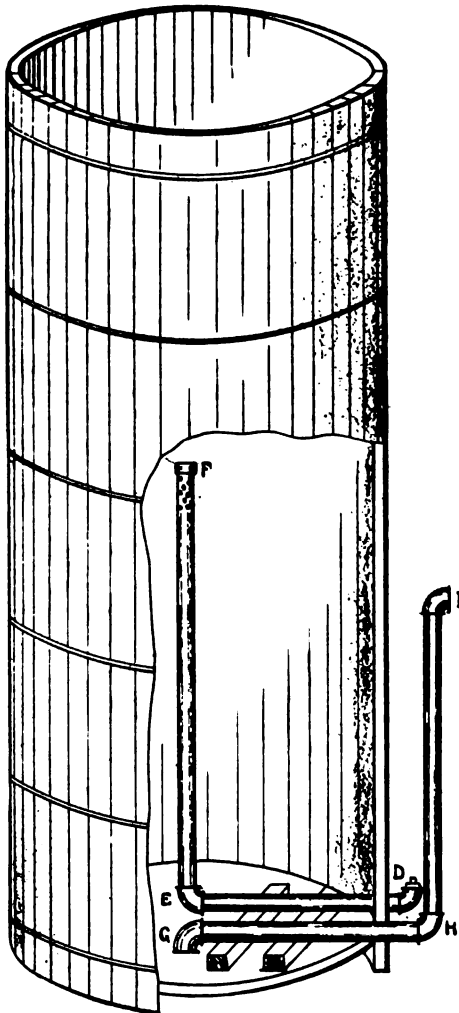
Silage Investigation Undertaken in 1901.

Introductory Comments.—The economic value of silage as a succulent winter food for stock is generally recognized by the farmer and dairyman. Successful animal husbandry, from a pecuniary point of view, depends almost wholly upon the cost of production. With this in mind, the Station has endeavored to discover some method of ensiling the large annual and perennial forage crops which will retain their natural palatability and succulence.

The method commonly employed does not produce these results and is objectionable for two reasons, (1) loss in food elements; (2) the presence of organic acids, the product of chemical or biological changes. The aim of the Station has been to secure an approximately acid-free silage that could be fed in sufficient quantities to supply a complete ration for a beef or dairy animal, or at least furnish the larger portion of the ration, so as to eliminate so far as practicable mill feeds.

In addition to the four silos maintained for work on a practical scale, five smaller ones were constructed for more technical work. This work with silage was also supplemented with extensive experiments conducted by the Departments of Chemistry and Bacteriology, some of which gave moderately good results, but none gave promise of a complete fulfillment of the object sought. During the progress of this work, Hon. Benton Killin, Chairman Station Committee, suggested the use of steam, the result of which is given in this publication. No attempt is made in this bulletin to draw conclusions because the work at this date is simply in the experimental stage. The principle seems correct, although many details remain to be worked out for the practical application of the method to farm conditions. Among these are the following: The amount of piping necessary for a given space in the silo and its proper distribution; steam pressure required; cost of operating; the discovery of an inexpensive method for sealing the silo, if found necessary to do so.

Construction of the Experimental Silos.—The experimental silos were constructed of well seasoned yellow fir, dressed, tongue and groove



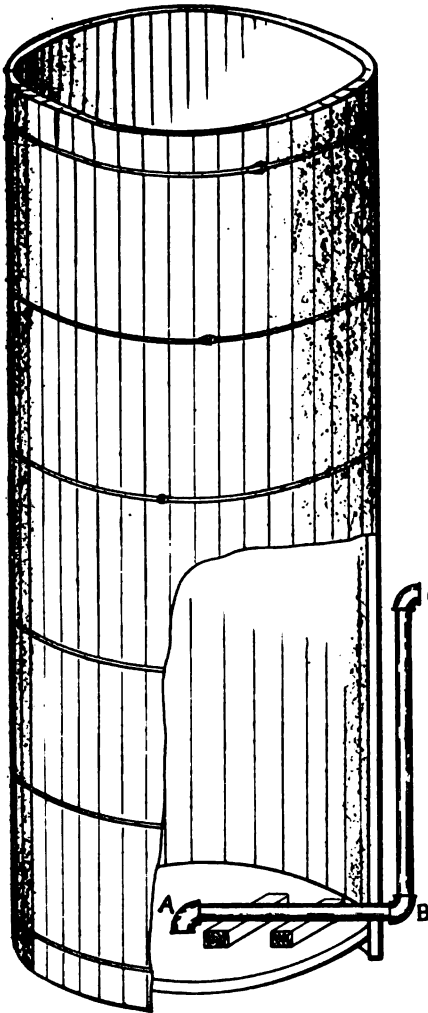
Silo No. 1.

lumber, $1\frac{1}{8}$ inches thick, $3\frac{1}{2}$ inches wide and 12 feet long. When completed the silos measured approximately 5 feet in diameter and 12 feet deep. They were constructed plain, having no doors, so that the only way of filling and emptying was by way of the top of the silo. Five such silos were constructed; two of them, numbers 1 and 5, were fitted with $1\frac{1}{4}$ inch piping so that they could be steamed after being filled. Silo No. 1 (see accompanying cut*) was fitted with pipes so that steam could be liberated in the silo within 2 inches of the bottom at G and also midway between the bottom and top at F. The upright pipe EF in the silo was covered with a cap at F so as to prevent fodder from falling into the pipe. Ten to 15 holes $\frac{1}{8}$ inch in diameter were drilled in the pipe near the cap at F as outlets for the steam. The elbow at G turns directly down and comes to within about

2 inches of the bottom of the silo. This elbow G prevents material from getting into the pipe GH and serves as an easy outlet for the steam when forcing it into the silo near the bottom.

* The drawings were kindly furnished by Mr. Clyde Phillips.

Silo No. 5 (see accompanying cut) was fitted with $1\frac{1}{4}$ inch piping so that the steam could be introduced into the silo near the bottom only.



Silo No. 5.

Filling the Silos.— Experimental silos numbers 1, 2, 4 and 5 were filled with very green immature corn fodder. Number 3 was filled with more mature corn fodder. The fodder was cut in the field and hauled immediately to the silos where it was cut with a steam cutter and elevated into the silos. The cutter was set so as to cut $\frac{3}{4}$ inch long. At the time of filling, the fodder was packed in the silos as tightly as possible, each silo receiving somewhat more than 3 tons of fodder.

Steaming the Silage.— Silo number 1 (see page 188) was filled with cut corn fodder Oct. 11, 1901. The material was well tramped and also tamped as firmly as possible with a piece of 2x4 scantling. The filling was completed at 6 o'clock P. M. Steam connections were made at D with pipe delivering steam at F six feet from bottom. (See cut page 188) At 7:20 P. M. steam under 20 pounds pressure was turned into the silo.

After 6 hours the steam had penetrated the whole upper portion of the silo and was coming out at the top. The steam was then turned off and connections made with the pipe at I delivering steam into the bottom of the silo at G. As soon as the connections had been made, the steam was again turned on. Early the following morning the steam pressure was

increased to 40 pounds with the steam valve leading to the silo wide open. At 9:30 A. M., Oct. 12 steam was shut off and boiler disconnected. A sterilized cotton plug was tied over the end of the pipe at I projecting from the silo. The second pipe projecting from the silo was stopped with an iron plug screwed in at D (see cut page 188.)

When steam was shut off the temperature on top of the cut fodder in the silo was 212° Fahr. and one foot below the surface a trifle above this temperature. During the steaming process the fodder shrank from $\frac{1}{4}$ to $\frac{1}{8}$ in bulk so that at the end of the steaming process the material in the silo occupied only $\frac{2}{3}$ to $\frac{3}{4}$ of the space originally occupied by it. There was practically no further settling of the silage after it was steamed.

Silo number 5 was filled with cut corn Oct. 5, 1901, the material being well packed as in silo number 1. After filling the silo, steam connections were made as described on page 189 and at 6:15 P. M., steam was turned in near the bottom of the silo at A (see cut page 189). The steam pressure on the whole was higher while steaming this silo than it was with silo number 1. The pressure ranged from 20 to 40 pounds and part of the time as high as 60 pounds. After 6 to 8 hours the steam had penetrated the whole silo from bottom to top. At 8 o'clock next morning the steam was shut off, the boiler disconnected and the end of the pipe at C (see cut page 189) projecting from the silo covered with sterilized cotton. During the steaming process the material in this silo shrank about as much as it did in silo number 1 when it was steamed so that at the end of the steaming process the material occupied only $\frac{2}{3}$ to $\frac{3}{4}$ of its original space. This was practically all the shrinkage which the silage underwent up to the time of emptying the silo.

Covering the Steamed Silage.—Just at the end of the steaming process, and while the corn fodder was still very hot, both silos were covered with layers of heavy building paper and then with several inches of sterilized cotton. This covering of paper and cotton was placed directly on top of the corn fodder so that if the fodder settled the cotton covering would settle also. It was thought that by this means these silos might be made more nearly germ proof.

Untreated Corn Silage.—On Oct. 5, 1901 silo number 4 was filled in the ordinary way with cut corn and was given no treatment whatever. This silage was to serve as a check on the steamed silage.

Salted Silage.—The Station Bacteriologist wished to try salting or pickling corn fodder and so silos numbers 2 and 3 were filled with cut corn and salted at the rate of one pound of salt for every 100 pounds of cut corn fodder. Silo number 2 was then saturated with water. Shortly after filling, silo No. 2 sprung a leak and the water drained off carrying with it much of the soluble portion of the silage.

Condition of the Corn Fodder.—The corn fodder used in this experimental work was very immature. Ears were just forming when the fodder was cut so that the silage contained little or no corn. Silo number 3 received the best fodder for silage; this fodder being more mature and the ears well formed. The kernels were soft however and not well glazed.

Opening the Silos.—Silo number 5 was opened Dec. 21, 1901. After carefully removing the cotton and paper, the silage was found to be mouldy, a white mould permeating the top layer of silage. After removing the top 12 inches of mouldy silage, the silage was bright and sweet and had the odor of sweet corn when it is being cooked.

Silo number 1 was opened Feb. 3, 1902, and after removing the cotton and paper the condition of the silage was just about the same as that of silo number 5. The top 3 or 4 inches were more or less decomposed and mouldy, the mould extending down about one foot below the surface. After removing the surface foot of silage the remainder of the silage was sweet and bright and had a most pleasant odor, not at all like ordinary silage.

It is doubtful if the layer of cotton served its purpose, since a layer of the silage spoiled. In all probability the silage would not have spoiled or fermented more than it did with no layer of cotton.

The check silo, number 4, was opened Jan. 25, 1902. The top layer was somewhat decomposed and mouldy. After removing the spoiled layer, the silage was bright and looked and smelled like ordinary corn silage, except that it was very immature and contained but little corn—possibly a more musty odor near the top and a more acid odor down in the silo than is usually experienced, probably due to this immature condition of the material when put into the silo.

The top layers of salted silos numbers 2 and 3 were more or less decomposed and musty. After removing the spoiled layers, the rest of the silage had a somewhat briny or pickled odor and of course was very salty to the taste.

Amount of Spoiled Silage.—The following table shows the amount of corn fodder put into each silo, also the amount of waste which had to be thrown out of each silo at the time of opening for feeding purposes:

Silo number	Date of filling	Am't cut corn fodder put in silo	Date of opening silo	Spoiled silage top of silo
1.....	October 11, 1901	6121 pounds	February 8, 1902	350 pounds
2.....	October 5, 1901	6140 pounds	February 24, 1902	665 pounds
3.....	October 2, 1901	6650 pounds	February 12, 1902	640 pounds
4.....	October 5, 1901	7248 pounds	January 25, 1902	740 pounds
5.....	October 5, 1901	6491 pounds	December 21, 1901	360 pounds

Discussion of Table.—The large percentage of loss from spoiled silage in these silos was evidently due to the smallness of the silos and the consequent resistance to the settling of the silage by friction from the walls of the silo. The better showing made by the steamed silage in Nos. 1 and 5 was doubtless due to the wilting of the silage from the effects of the heat and to its greater weight per cubic foot, due perhaps to moisture acquired from the condensation of steam.

Feeding the Silage and Results.—Owing to the small quantity of steamed silage no experimental feeding was undertaken to determine its value as compared with silage put up in the ordinary way. The cows ate it with avidity and seemed to do well on it.

The Chemistry of Silage.

A Chemical Study of Silage.—Corn silage, as it usually comes from the silo, has undergone many changes since the time when the green material was put into the silo. One of the best ways of noting changes in silage is to keep track of the acidity. If the acidity of the material increases to any great extent, it is a sure indication that many changes have taken place in the silage in the silo; if the acidity does not increase then but few changes have taken place.

Untreated Silage from Immature Corn.—On Oct. 1, 1900, very immature cut corn fodder was put into a silo in the ordinary way. The acidity of the fresh material was not determined, but from examinations of other fresh samples of cut corn fodder, it probably ranged from .10 to .15 per cent. When the silage was fed the latter part of April and May, 1901, it contained on an average 1.94 per cent acidity calculated as acetic acid. One of the partial samples contained as much as 2.22 per cent acid. This large increase in acidity indicated that the silage had undergone great changes. The following table gives these changes:

	Water-free Material.		Fresh Material.	
	No. 1849	No. 1906	No. 1849	No. 1906
	Cut corn as put in silo Oct. 1, 1900.	Composite sample corn silage as taken out of silo from April 30 to May 15, 1901.	Cut corn as put in silo Oct. 1, 1900.	Composite sample corn silage as taken out of silo from April 30 to May 15, 1901.
		No treatment		No treatment
	Per cent.	Per cent.	Per cent.	Per cent.
Ash.....	5.65	6.19	1.40	1.23
Protein.....	9.13	10.31	2.27	2.05
Ether extract.....	2.93	5.83	0.78	1.16
Crude fiber.....	19.35	21.15	4.80	4.21
Sugars (cane and invert).....	17.79	1.40	4.42	0.28
Acids (calculated as acetic).....		9.74		1.84
Moisture.....			75.18	80.09
Dry matter.....			24.82	19.91

A study of this table shows that the greatest changes were undergone by the carbohydrates. An examination of the water-free material shows that when put in the silo the fodder contained 17.79 per cent sugar (cane and invert), at the time of taking out of the silo 1.40 per cent, or a loss of 92.13 per cent. This loss consisted of canesugar, dextrose, laevulose, and in all probability small amounts of other carbohydrates. When calculated to the fresh material, we find that when it went into the silo it contained 4.42 per cent total sugar, and that when taken from the silo this amount had decreased to 0.28 per cent. With this large loss of carbohydrates there is a large gain in acidity and apparently small gains in the other component parts of the silage. Since a considerable portion of the carbohydrates during fermentation escapes from the silo in the form of gases, this would increase the percentage composition of the remaining component parts of the silage, even though they had undergone no change.

The following year similar experiments were conducted. Oct. 5, 1901, experimental silo No. 4 was filled with very immature corn fodder. This silo was given no treatment other than that given the ordinary silo. On Jan. 25, 1902, this silo was opened and the feeding of the silage began. The following table gives the changes which the material underwent in the silo:

	Water-free Material.		Fresh Material.	
	No. 2073	No. 2289	No. 2073	No. 2289
	Cut corn as put in silo No. 4, Oct. 5, 1901.	Composite sample corn silage as taken out of silo No. 4 from Jan. 25 to Feb. 3, 1902.	Cut corn as put in silo No. 4, Oct. 5, 1901.	Composite sample corn silage as taken out of silo No. 4 from Jan. 25 to Feb. 3, 1902.
		No Treatment.		No Treatment.
	Per cent.	Per cent.	Per cent.	Per cent.
Ash.....	6.61	8.49	1.70	1.43
Protein.....	7.31	8.13	1.88	1.37
Ether extract.....	3.55	5.89	0.91	0.99
Crude fiber.....	21.75	25.02	5.58	4.21
Sugars (cane and invert).....	17.40	1.22	4.46	0.21
Acids (calculated as acetic).....	0.47	10.59	0.12	1.78
Moisture.....			74.34	83.19
Dry matter.....			25.66	16.81

An examination of this table shows that when the fodder was cut and put in the silo it contained 0.12 per cent acid calculated as acetic, when taken from the silo this acidity had increased to 1.78 per cent, being very nearly sixteen times the original amount in the fodder. Here again as in last year's work we find that this large gain in acidity is accompanied by a corresponding large loss in carbohydrates. Calculated to a water-free basis, we find that when the fodder was put in the silo it contained 17.40 per cent sugar (cane and invert) and that when taken from the silo this amount had decreased to 1.22 per cent being a loss of 92.99 per cent in sugars. When calculated to the fresh material we find that when it went into the silo it contained 4.46 per cent total sugar and that when taken from the silo this amount had decreased to 0.21 per cent.

It is believed that the silage as it came from the silo contained not even a trace of sugar in any form because after digesting a water extract of the fresh silage for 15 minutes with hydrochloric acid, a careful examination of this digested extract failed to show any reducing sugar present. However, after drying the silage thoroughly at 100 degrees centigrade and grinding to a powder in a Maercker's mill, a careful analysis of the water extract of this fine powder, after digesting with hydrochloric acid, gave 0.21 per cent reducing sugars.

Salted Silage.—In the fall of 1901 another experiment was com-

menced; On Oct. 5, Experimental Silo No. 2 was filled with immature corn fodder. During the filling process the corn fodder was salted from time to time at the rate of one pound of salt to each 100 pounds of corn fodder. After filling, the material in the silo was thoroughly saturated with water. Another Experimental Silo No. 3, was filled on Oct. 6, 1901 with corn fodder which was much more mature, the ears were well formed and the kernels glazed. This silo was also salted at the rate of one pound of salt to each 100 pounds of green corn fodder. No water was added to this silo.

The following table shows the changes undergone by the salted silage:

Water-free Material.				
	No. 2073	No. 2306	No. 2074	No. 2292
	Cut corn as put in silo No. 2, Oct. 5, 1901.	Composite sample corn silage as taken out of silo No. 2 from Feb. 24 to Feb. 28, 1902	*Cut corn one day after putting in silo No. 3, Oct. 6, 1902.	Composite sample corn silage as taken out of silo No. 3 from Feb. 12 to Feb. 21, 1902
		Salted and watered.		Salted.
	Per cent.	Per cent.	Per cent.	Per cent.
Ash	6.61	7.99	7.89	10.45
Protein	7.31	7.13	10.81	9.13
Ether extract	3.56	5.35	3.77	5.96
Crude fiber	21.75	27.28	20.70	19.80
Sugars (cane and invert)	17.40	0.79	11.28	2.24
Acids (calculated as acetic)	0.47	8.16		7.78
Fresh Material.				
Moisture	74.84	87.26	77.70	79.45
Dry matter	25.66	12.74	22.30	20.56
Ash	1.70	1.02	1.76	2.15
Protein	1.88	0.91	2.41	1.88
Ether extract	0.91	0.68	0.84	1.22
Crude fiber	5.58	3.48	4.62	4.07
Sugars (cane and invert)	4.46	0.10	2.52	0.46
Acids (calculated as acetic)	0.12	1.04		1.60

*Owing to an oversight the composite sample of fodder put in silo No. 3 was not saved. A sample was taken next morning—probably fifteen hours after the silo had been filled. At this time the material in the silo was beginning to heat and much of the sugar had disappeared.

This salted silage underwent rather more changes than were expected. The salt did not seem to prevent to any great extent fermentation and the formation of acids. The sugars had practically all disappeared during the changes taking place in the silos. However, upon drying the silage and grinding and digesting a water extract of this ground silage with acid, a small amount of sub-

stance, namely 0.10 per cent in silo No. 2 and 0.46 per cent in silo No. 3, was found which would reduce Fehling's solution.

By examining the foregoing table we find that the fodder calculated to a water-free basis, when put into silo No. 2, contained 17.40 per cent total reducing sugars and 0.47 per cent acidity calculated as acetic acid. When taken out of the silo the sugars had decreased to 0.79 per cent whilst the acidity had increased from 0.47 per cent to 8.16 per cent. These results when reduced to the fresh material are as follows: when put into the silo the green corn fodder contained 4.46 per cent reducing sugars and 0.12 per cent acid. When taken out of the silo the sugars had decreased to 0.10 per cent and the acidity had increased to 1.04 per cent.

From a practical point of view it would not be advisable to salt the fodder and then saturate it with water, because salt solutions tend to dissolve out some of the valuable parts of the fodder. A considerable proportion of the protein being easily soluble in salt solutions.

Steamed Silage.—The most interesting part of the year's work with silage centered about the silos which had been steamed. The work this last year was purely experimental and the results obtained were far beyond the Station's expectations. The process of filling and steaming the silos is described on pages 189 and 190. The silage coming from the steamed silos was sweet and had undergone very little change since the green fodder was put into them.

The following table shows the changes which have taken place in the steamed silage:

Water-free Material.				
	No. 2073	No. 2268	No. 2080	No. 2291
	Cut corn as put in silo No. 5, Oct. 5, 1901.	Composite sample corn silage as taken out of silo No. 5 from Dec. 21 to Jan. 16, 1902.	Cut corn as put in silo No. 1, Oct. 11, 1901.	Composite sample corn silage as taken out of silo No. 1 from Feb. 3 to Feb. 11, 1902.
		Steamed.		Steamed.
	Per cent.	Per cent.	Per cent.	Per cent.
Ash.....	6.61	6.85	6.08	6.38
Protein.....	7.31	7.38	8.81	7.56
Ether extract.....	3.55	3.60	3.21	3.80
Crude fiber.....	21.75	22.40	17.75	21.18
Sugars (cane and invert).....	17.40	17.44	18.14	16.25
Acids (calculated as acetic).....	0.47	1.62	0.47	1.68

Fresh Material.				
Moisture.....	74.34	81.51	74.34	78.50
Dry matter.....	25.66	18.49	25.66	21.50
Ash.....	1.70	1.17	1.56	1.37
Protein.....	1.88	1.36	2.13	1.62
Ether extract.....	0.91	0.67	0.82	0.82
Crude fiber.....	5.58	4.14	4.55	4.55
Sugars (cane and invert).....	4.46	3.22	4.65	3.49
Acids (calculated as acetic).....	0.12	0.30	0.12	0.35

By carefully examining the analysis of the water-free material in the above table it is seen that of all the silage considered in this bulletin, the steamed silage underwent the fewest changes. The sugars which usually undergo the most change in the silo were not altered to any great extent and were found in approximately their original amounts.

During the changes taking place in the silos the acidity increased somewhat but instead of finding 8 to 10 per cent acid we find only 1.62 per cent. These results when reduced to the fresh material just as it came from the silo show that the steamed silage contained about .30 per cent whilst the ordinary silage contained from 1.78 to 1.94 per cent acid. In other words the ordinary corn silage contained six times as much acidity as the steamed silage.

Sugar and Acidity in Fresh Silage.—In all the experimental work with silage, when the material was taken out of the silos for feeding purposes, partial samples were taken for analysis. Determinations were made for acidity and sugar in the water extract of the fresh silage. The following partial analyses of the fresh material will give a fair indication of the condition of the silage as it came from the different experimental silos. It will be noticed that the water extract of the silage contained no sugar except in the two cases where the silage had been steamed. These partial analyses are as follows:

	Large Silo		Exp. Silo No. 1.		Exp. Silo No. 2.		Exp. Silo No. 3.		Exp. Silo No. 4.		Exp. Silo No. 5.	
	No treatment.		Steamed.		Salted.		Salted.		No treatment. Check.		Steamed.	
Sugar and acid contained in corn fodder when put in silo.	Sugar Per cent. 4.42	Acid Per cent.	Sugar Per cent. 4.65	Acid Per cent. 0.12	Sugar Per cent. 4.46	Acid Per cent. 0.12	Sugar Per cent.	Acid Per cent.	Sugar Per cent. 4.46	Acid Per cent. 0.12	Sugar Per cent. 4.46	Acid Per cent. 0.12
1st sample silage as taken out of silo		2.22	2.49	0.66	None	0.96	None	1.14	None	1.68	2.99	0.36
2d sample		1.92	3.26	0.48	None	1.02	None	1.74	None	1.74	3.32	0.27
3d sample		1.68	3.29	0.30	None	1.14	Trace	1.38	None	1.80	3.18	0.45
4th sample			3.72	0.33	None	1.08	None	1.38	None	1.89	3.82	0.30
5th sample			3.97	0.30	None	1.02	None	1.77	None	1.80	3.49	0.27
6th sample			3.74	0.24			None	1.80	None	1.74	3.58	0.24
7th sample			3.70	0.24			None	1.80			3.40	0.27
8th sample			3.70	0.27			None	1.80			4.24	0.36
9th sample											4.01	0.21
10th sample											3.43	0.30
11th sample											4.04	0.30
12th sample											3.32	0.27
13th sample												0.36
14th sample											3.68	0.30
15th sample											3.16	0.24
16th sample												0.24

Methods and Table of Analyses of Silage Materials.—The following table gives the complete fodder analysis of the materials used in the corn silage experiments. The methods of analysis used are those adopted by the Association of Official Agricultural Chemists.

A departure was made from the routine method of fodder analysis when the carbohydrates were examined. Under the heading "Carbohydrates" is included all those materials which are capable of hydrolysis. For this determination 2 grams of dry substance were boiled two and one-half hours with 200 cubic centimeters of water and 20 cubic centimeters of hydrochloric acid (specific gravity 1.125) in a flask provided with a reflux condenser; then cooled, neutralized, filtered and the reducing sugars determined in a portion of this filtrate. The reducing sugars thus obtained would include cane and invert sugar, starches, pentosans and such other carbohydrates which undergo hydrolysis and conversion into reducing sugars when boiled with hydrochloric acid. Concerning the nitrogen compounds it is seen that with the chemical and biological changes taking place in the silos the tendency was for the proportion of albuminoid nitrogen to diminish whilst the amide nitrogen increased. The steamed silage contained the least amide nitrogen of any of the samples of silage examined. The amount of ether extract in the untreated silage and also in the salted silage had increased greatly during the time that the material was in the silos, whilst the ether extract in the steamed silage changed but very little. The crude fiber in the silage in one of the salted silos increased greatly because a considerable amount of the soluble portion of the silage leaked out of this silo.

Silage Work—Summer of 1902.

Present Status of the Work.—Since the work last year, which is discussed in this bulletin, was purely experimental, no attempt will be made to draw conclusions. During the present season the Station is carrying out several experiments and is steaming a number of large and small silos.

Two silos filled in June 1902 were piped as follows: One nine feet in diameter and twenty-two feet deep was supplied with a four-foot-square of one inch pipe placed about eight inches from the floor upon blocks in the center of the silo. This pipe was perforated on the under side with one-fourth inch holes about four inches apart. To this was attached a supply pipe passing through the walls of the silo and barn. On the outside of the barn a vertical pipe of five feet was attached and a horizontal pipe twelve feet long connected this to the boiler of the farm traction engine. On June 10th, this silo was filled with whole clover. After the silo was filled steam was turned on and continued for fourteen hours with a pressure fluctuating from twenty-five to forty pounds. At the end of this time the contents of the silo, consisting of 11.86 tons, were thoroughly heated. The following day the silo was filled up again and the steaming renewed.

Another silo ten feet in diameter and twenty-two feet deep, was similarly piped except in addition to the square, an individual vertical pipe extending up fourteen feet and perforated with several one-fourth inch holes near the top was placed in the center of the silo. After partially filling this silo on June 12th and 13th with cut clover, steam was turned on in the square of pipe at the bottom of the silo for sixteen hours. On June 14th, the silo was filled up again and steam turned on in the vertical pipe for about forty hours. This last steaming was not satisfactory as the heat appeared to be unevenly distributed throughout the material put in at the last filling. This silo contained 36.46 tons and required from one to one and one-half cords 4 ft. fir wood to steam it. No attempt was made to seal these silos but the surface was kept thoroughly compact by tramping for a short while each day for a week.

The outside vertical and horizontal pipes may be used for steaming a number of silos but should be detached from the pipe leading into the silo while hot. This pipe must be immediately plugged with

cotton so as to exclude germs that might enter with air going in to fill partial vacuums produced by the cooling of the silage.

On June 21, 1902 Experimental Silo No. 5 (see page 189) was filled with cut clover more mature than was put in the large silo June 14. It required 5855 pounds of cut clover to fill it. This silo was steamed for twelve hours commencing at 11:40 A. M. June 21. During the steaming process the clover settled nearly six feet.

The Station has planned to fill Experimental Silo No. 1 (see page 188) with still riper cut clover and steam immediately after filling by forcing steam in, both at the bottom and afterward at the center of the silo. The Station will also fill one of the large silos nine feet in diameter and twenty-two feet deep with cut vetch. This silo will be thoroughly steamed as soon as filled.

Later in the season three or four more silos will be filled with cut corn and steamed. It is hoped that in this way the Station will be able to demonstrate the success or failure of the Oregon method of ensiling crops.

Steaming Immediately After Putting Material in the Silo is Essential.—

Since green materials when cut and packed tightly undergo chemical or biological changes very quickly, it is necessary that the materials be steamed as soon as possible after ensiling. Last October corn fodder put into a silo untreated sustained a loss of one-fifth or twenty per cent in sugar content during the first twelve hours in the silo.

Conclusions.—At the present writing no conclusions will be drawn as the Station has but scanty data upon which to found them. The Station believes that it is working in the right direction but at the present time feels warranted only in giving a report of progress concerning steamed silage.

LIST OF BULLETINS

(In print) published by the Oregon Agricultural Experiment Station to July, 1902.

Circular No. 1—Dairying in Oregon	Shaw, French and Kent
No. 6, 1890—Chemistry, Zoölogy	Washburn
No. 7, 1890—Small Fruits and Vegetables	Coote
No. 8, 1891—Varieties of Wheat and Flax	French
No. 10, 1891—Entomology	Washburn
No. 28, 1894—Pig Feeding, continued	French
No. 29, 1894—Horticulture, Pruning, etc.	Coote
No. 30, 1894—Potatoes and Roots, continued ..	French
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No. 32, 1894—Five Farmers' Foes	Craig
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No. 36, 1895—Composition and Use of Fertilizers ..	Shaw
No. 37, 1895—Experiments in Cattle Feeding ..	French
No. 38, 1895—Fruit Pests	Washburn
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No. 43, 1897—Flax Culture	French
No. 44, 1897—Review of Oregon Sugar Beets ..	Shaw
No. 47, 1897—Cheat and Clover	Shaw and French
No. 48, 1898—Spraying	Cordley
No. 50, 1898—The Fertility of Oregon Soils ..	Shaw
No. 51, 1898—Marketing Fruit	Craig
No. 52, 1898—Nut Culture	Coote
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No. 54, 1898—Flax, Hemp, Dairy, etc.	French and Kent
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No. 59, 1899—Sugar Beet Experiments of 1898 ..	Shaw
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No. 61, 1900—The Oregon Prune	Shaw
No. 62, 1900—Miscellaneous Investigations ..	Shaw
No. 63, 1900—Prevention of Smut on Oats—Preliminary Bulletin	Pernot
No. 64, 1901—Investigation of Diseases in Poultry ..	Pernot
Circular Bulletin concerning Acid Soils in Oregon—1900	Knisely
No. 65, 1901—Creameries and Cheese Factories of Western Oregon	Kent
No. 66, 1901—The Grape in Oregon	Lake
No. 67, 1901—The Silo and Silage	Withycombe
No. 68, 1902—Birds of Oregon	Woodcock
No. 69, 1902—The Codling Moth and Late Spraying in Oregon ..	Cordley
No. 70, 1902—Testing Milk and Cream	Kent
No. 71, 1902—Stagnant Water Germs in Milk ..	Pernot
No. 72, 1902—Preliminary Report on Steamed Silage	Withycombe and Knisely

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SEP 9. 1902
J. H. L.

Bulletin No. 73.

October, 1902.

DEPARTMENT OF BACTERIOLOGY.

OREGON AGRICULTURAL EXPERIMENT STATION,
CORVALLIS, OREGON.

Notes on Vinegar Making.

By E. F. PERNOT.

**The Bulletins of this Station are sent Free to all Residents of
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NOTES ON VINEGAR MAKING.

As the prune industry in this state develops, growers realize that there is an increased amount of prunes, which through many causes, become unfit for drying purposes, prunes which are over ripe, and those bursted open, under sized prunes, and unsaleable ones, all go to make up a large product which is annually wasted. The utilization of waste products goes far towards defraying the expenses of raising the crop. With this in view, an experiment was begun September 25th, 1901, in making vinegar from the waste prunes which were rejected for drying at the experiment station. No prunes were used that were in any way decomposed. The first problem that arose, was, how to extract the clear liquid, the prunes being of such peculiar structure that the juice could not be extracted by pressure, without being thick and turbid. In order to overcome this difficulty a vat was constructed of the following dimensions, which answered the purpose admirably, although it was too large for the amount of prunes available.

The foundation of the vat consisted of cross pieces 3 feet 10 inches long varying in height from 8 in. to 13 inches which gave an incline to the tank bottom, to these cross pieces fir flooring was toe-nailed and the joints were painted with thick white lead, the surface was painted and a second floor laid on top in a similar manner, making a double floor, water tight, 13 ft. 2 in. long, 3 ft. 10 in. wide. Near the edge of this floor, a strip 1x2 inches was leaded and nailed all around except at the lower end, where two strips were nailed diagonally so as to form a spout. A second strip 2x4 was fastened to the floor two inches inside of the outer one, so as to form a gutter between the two, instead of nailing it tight to the floor it was provided with thin cross strips at intervals of about eight inches so as to allow the liquid to pass into the gutter. On the inner side of this strip, flooring four feet long was toe-nailed in an upright position, but before nailing, a strip of burlap about two inches wide was placed between the ends of the boards and tank bottom so as to form a filter. Midway up and at the top, the sides were toe-nailed to frames of 2x4 material, thus forming a strong tank free from obstructions inside. No nails were allowed to be exposed nor to come in contact with the prunes or juice.

On the top of the vat, a large hopper was constructed provided

at its lower end with a large wooden roller in which were driven nails projecting about three-fourths of an inch from its surface, a crank was fastened to the end of the roller and allowed to extend across the outside of the vat.

The prunes, after being washed and weighed, were put into the hopper, and by turning the crank they were torn and passed to the vat below. After several bushels of prunes had accumulated in the vat, they were inoculated with a pure culture of yeast *saccharomyces cerevisia*, which caused a strong and rapid fermentation, the cell walls of the prunes were thus broken down, liberating the clear juice, which poured into the receptacle below the vat. The object of lacerating the prunes with the spiked roller, was to allow the ferment to more readily destroy the cell walls. This method of extracting the prune juice was inexpensive and perfectly satisfactory. In this experiment 10,482 pounds of Italian prunes was used, from which 630 gallons of juice was obtained, a yield of over three gallons per bushel, greatly exceeding expectations.

As the prune juice was collected, it was emptied into open barrels and there allowed to remain undisturbed for ten days, when fermentation ceased. An analysis at that time showed ten per cent alcohol.

After the liquid in all the barrels had ceased fermenting, a pure culture of acetic acid germs, *bacilli Pasteuranum*, which had previously been prepared in the laboratory, was floated on the surface of the liquid by the aid of thin pieces of cork, weighted, so as to bring the culture in contact with the liquid, in course of time a delicate scum spread over the entire surface of the liquid and the formation of acetic acid began. Every month the material was tested for acetic acid and was found to vary considerably although the barrels were kept under similar conditions, the highest test at the present time is 3.43 per cent acid.

At the same time that the prune juice was placed in the barrels, several half-gallon jars were filled and kept in the laboratory; one jar in which the liquid has evaporated to a considerable extent tests as high as 8.59 per cent acid, and another one tests 6.73 per cent; this was due to the volume of material being smaller than in the barrel, and the temperature higher. The barrels were left in the dryer until the latter part of October, when it was found that the formation of acetic acid had almost ceased, owing to the low temperature, they were then moved to the cellar of the horticultural

building where a warmer atmosphere prevailed. The progress of vinegar making was thus very much impaired by the liquid having been disturbed; as the barrels had no heads, it was necessary to use the syphon in conveying it from the barrels above ground to those in the cellar, consequently the cultures which had formed a scum on the surface, were destroyed, necessitating a reinoculation to form a new scum. The vinegar is of an excellent quality, possessing a fruity flavor, it has a good body, analyzing 6.87 per cent total solids, and the only objection that can be raised is to the color, which is that of very dark wine.

There can be but little objection to its color however, since it is but little, if any, darker than the imported malt vinegar which finds ready sale in our markets, and it is probable that some way will yet be found to clarify it and reduce the color. Experiments are now in progress for making vinegar from Petite prunes, and from Italian prunes from which the skins were removed, to see if the dark color could be obviated. A new vat was constructed on the principle of the old fashioned ash leech and it is found to work very satisfactorily.

It is perhaps not out of place here to give a brief description of the formation of vinegar (acetic acid) from fruit juices.

To obtain the best results, or highest per cent of acetic acid from fruit, it should be fully ripened so as to contain the maximum amount of saccharine matter, this is first acted upon by ferments, which find it a suitable material to grow in, and in so doing the sugar is consumed, being split up into other elements, the principal one being alcohol, carbonic acid gas being liberated at the same time, passes away, leaving a liquid composed of water, alcohol, organic and mineral solids; the amount of alcohol varying according to the amount of saccharine matter in the fruit juice. After the alcoholic fermentation takes place, other organisms find the material conducive to their development, and begin their activities. They consume alcohol, converting it into acetic acid. It is absolutely necessary that these organisms have unobstructed access to all the air that they desire, or oxidization through their activities will be impaired. Therefore a barrel filled with fruit juice and bunged can not form vinegar as rapidly as one half filled, and with the bung taken out.

It is the habit of many people to fill a barrel with cider which they intend for vinegar, and in place of the bung, to insert an empty

quart bottle in the bung hole. This is not only useless, but detrimental, as it excludes the organisms necessary to form vinegar and shuts out the air which is requisite for those which may already happen to be in the liquid.

There is a small yellow fly, *Drasophila ampelophila*, commonly known as pomace fly, vinegar fly, and drunkards, which frequent the vicinity of vinegar barrels and decomposing fruit. They are instrumental in carrying from place to place the acetic acid germs and ferments, doing more good than harm to material which is intended for vinegar. This was demonstrated in the laboratory in the following manner: Some of these small flies were caught by the wings with sterile forceps while they were at work on the open barrels of prune juice, they were conveyed to the laboratory and liberated under the cover of shallow dishes which contained sterile culture media, and there allowed to remain long enough to walk several times across the surface of the material, and then liberated; the dishes were then placed in an incubator for twenty-four hours, after which time there was a visible growth of acetic acid germs where their feet had touched the media. The bodies of these flies were then taken and crushed between a microscope slide and cover glass, and examined under a high power microscope; it was found that the digestive tract contained an immense number of acetic acid germs, and yeast plants, which the fly had taken up with its food. In order to determine whether the organisms had lost their vitality in passing through the digestive organs of the fly, several flasks of fresh cider were sterilized, the flasks were provided with the usual cotton plug, with the exception of having a small glass tube passing through the center, which was also plugged with cotton at its outer end. When all were perfectly sterile, flies were caught under aseptic precautions, and one fly dropped into the liquid of each flask through the small tube, the plugs were replaced and the flasks placed in the incubator, after remaining there for forty-eight hours, a fermentation had taken place and they were removed to the temperature of the laboratory. After eight months the flasks were opened and the material tested for acetic acid, one flask testing as high as 3.29 per cent acid, a fairly good vinegar, the other flasks were of a lower percentage. A check flask was prepared in the same manner as the others, with the exception of not being inoculated with a fly and being kept under the same condition, it remained sterile.

While it appears that the pomace fly renders a valuable service in inoculating fruit juices with the necessary germs for producing vinegar, they are also apt to carry spores of moulds and other organisms, which impart a bad odor or taste to the finished product.

Therefore instead of relying upon accidental inoculations, vinegar of standard taste may be produced by using cultures of selected ferments, in the same manner as the flavor of wine and beer is controlled by the manufacturer. In the bacteriological laboratory of this station, pure cultures of the acetic acid ferments are constantly kept on hand, and will be furnished to anyone in this state upon application.

Most of the pure fruit-juice vinegars, contain *angnilla aceti*, commonly known as vinegar eels, which are large enough to be seen with the naked eye, and resemble eels both in form and movement. They are a detriment to the vinegar inasmuch as they consume the material, and at death sink to the bottom of the receptacle, where, if they decompose, unpleasant odors and tastes are imparted to the product in consequence. It is difficult to prevent their entering the material and still more difficult to remove them when established.

Fruit juices, especially apple cider, contain a certain amount of albuminous matter, which, as the acetic acid fermentation increases, becomes coagulated, forming a scum which gradually thickens as it becomes older, if one surface of this is exposed to the air, it dries and becomes a leathery mass familiarly termed, "mother of vinegar," it contains an immense number of the acetic acid germs, and is useful in inoculating fresh material which is to be converted into vinegar.

The process of making vinegar for home use, or even for market, is simple and quite within reach of everyone, the first requisite is to have perfectly clean barrels or vats. This may be accomplished by thoroughly scalding several times with boiling water or live steam, so as to destroy the spores of moulds which may be present. Well ripened fruit should be used, because it contains a greater amount of sugar, and will yield a higher per cent of acetic acid. Fruit that is decomposed, should not be used. After the juices have been obtained and emptied into the receptacles, dissolve a yeast cake in a small amount of liquid, pour it into the mass and thoroughly stir with a clean stick, a strong fermentation will soon take place which should be allowed to continue undisturbed until

it ceases of its own accord, then procure some "mother of vinegar" from a sample which suits the taste, or a pure culture of acetic acid germs, and float it upon the surface of the liquid by means of a few clean straws, and leave undisturbed in a warm place. A delicate scum, which must not be broken, will soon form on the surface of the liquid. The rapidity of the transformation to vinegar will depend upon the temperature at which the material is kept. A temperature of 80 degrees F. will give the most rapid results.

Apple vinegar has been made in this manner at the station, which, in four months, yielded a delicious tasting article, that tested six per cent acetic acid, and five gallons of vinegar from pears made last year, in five months, tested 8.89 per cent acetic acid. This was strong enough to be diluted one half with water, and still be stronger than the law of this state requires, which is four per cent. To recapitulate—there are several conditions to be considered in making vinegar in this way. The barrels must be free from must and mould, the depth of the liquid should not exceed the surface measure, free air must be continually admitted, an even, warm temperature should be maintained and, last but not least, the fruit that is used should be free from decay and mould.

There is no reason why all the fruit which annually goes to waste in this state, cannot be made into good, wholesome vinegar for our home consumption and for export trade, instead of importing an unwholesome article, made from distillery refuse, which floods our markets. Not only would it become a source of income, but it would remove from our orchards material which decays and becomes an asylum for insect pests and fungus diseases.

There are other methods of making vinegar from fruit juices, *i. e.* with generators, which are much more rapid in their action. The principle is simply to expose to the air broad surfaces of liquid to increase the action of oxidization through the activities of acetic acid ferments. Any device so constructed, as to allow a small stream of inoculated cider to flow slowly over a series of inclined surfaces, in the presence of warm air, will form acetic acid much more rapidly than if the same material were placed in deep vats or barrels, because the organisms which are instrumental in the conversion of acetic acid, require an abundance of oxygen. Beech shavings are sometimes used, because their many surfaces in the aggregate present a large area and no bad taste is imparted to the vinegar from that wood.

5000.

Bulletin No. 74.

February, 1903.

HORTICULTURAL DEPARTMENT.

OREGON AGRICULTURAL EXPERIMENT STATION,

CORVALLIS, OREGON.

THE CULTIVATION OF VEGETABLES AND NOTES ON VARIETIES.

By GEORGE COOTE.

The Bulletins of this Station are sent Free to all Residents of
Oregon who request them.

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THE CULTIVATION OF VEGETABLES AND NOTES ON VARIETIES.

THE ONION.

FROM time immemorial the onion has been cultivated. It is supposed to be indigenous to India. From there it passed into Egypt, where it was cultivated 2000 years B. C. The onions of Egypt are probably the finest and most delicately flavored of any grown. This is due to the fertile soil and balmy climate of that country. From Egypt, it spread into Greece and Italy, and gradually from there all over Europe.

This bulletin will touch upon the so called "new onion culture," which, by the way, is so old, that like fashions and other things, it has been resurrected within the last few years. This method was introduced into England by Worlidge, early in the seventeenth century; nearly four hundred, years ago. He not only clearly demonstrated that he could, by this method, produce a large onion, but also one which would keep better.

By this method seed may be sown in the open as early as the middle of September or it can be sown later in boxes, say in January. These boxes should be kept in a gentle heat, and as soon as the young plants are large enough to handle, they should be pricked out or reset in other boxes or cool frame. This is necessary in order to give the young plants strength and more room to expand. When the plants are from 6 to 8 inches high, they are large enough to be planted out in the open field. Now, this field should be heavily manured in the fall, plowed as deeply as possible and left until ready to plant in the spring when it will easily work into good condition. The reason for leaving the ground rough after the plow, is that it will give better drainage, causing it to dry earlier in the spring and thus permit of an early planting. If these details have been carefully observed, planting may be done with the very first dry weather in April or early part of May, taking care not to work the ground while wet, but taking the first opportunity to harrow it as soon as it is dry on the surface.

After the ground has been properly worked, planting may be commenced, setting the plants from 5 to 6 inches apart in the row, and 15 to 18 inches between the rows. This distance will give a good opportunity for cultivating between the rows, which, by the way, should be done as often as weeds appear, during the season of growth.

From the results of experiments that have been made, the last three seasons have shown that the above method is much preferable for upland cultivation, as excellent results have been had. To those who have not the water at hand for irrigation purposes, this method is highly recommended. The soil should be prepared the same as for raising from seed.

Cultivation of the Onion From Seed.

The actual time for planting onion seed cannot be stated. This will greatly depend upon the season and the state of the weather and condition of the soil from the middle of February to the second week in April, although the latter would be considered getting late for sowing. However it is better to be a little late than to sow the seed when the soil is not in condition to be seeded. About the middle of March is the proper time for sowing the seed, therefore the first opportunity should be taken when the ground is in proper order, the ground having been previously well enriched and rendered pliable by early fall plowing.

After the plants have made a growth of from one to two inches high, cultivation should commence. This may be done with a hand cultivator or with the hoe. At this stage of growth care should be taken not to permit the weeds to overpower the young onion plants. Therefore careful watching and a thorough hand weeding must be done at this time; afterwards frequent cultivation should be resorted to and the oftener the better in dry weather, where irrigation is not practicable.

Supposing the location to be some old swamp or beaver-dam land and the water having been previously well drained off, and wishing to grow a crop of onions on such land, the first thing in the way of the preparation of such soil would be, to plow very deep early in the fall leaving the surface of the ground rough so that the frost may penetrate through the soil as much as possible. The frost will help to sweeten the soil, that is it will have the tendency

to take out the sourness that is left in the soil which has been caused by a constant overflow of water. Such land would always be benefited by the application of lime.

Onions should not be grown year after year on the same ground. A change of location is essential for many reasons. First, onions like many other growing crops become diseased. Secondly, insect pests deposit their eggs in the soil. These hatch and as soon as the next crop is ready they proceed to devour it, so that a change is good at all times both for the crop and land.

The growth of the onion will not deteriorate by the surface being rather compact, provided the soil can be kept moist by such irrigation. If not, the soil must be kept well stirred at intervals through the growing season. Upon this depends a great deal of the success in the growing of the onion crop.

Onions grown by a system of irrigation, though they yield well under its treatment, do not make the best for keeping long; these should be turned off to the markets at the earliest possible date, keeping those that have not been so heavily irrigated for the later market. Another good plan is to cease the irrigation some time before the crop matures. It is very essential that the crop be perfectly matured, if it is intended to keep it over any length of time. During our moist winters in the Willamette valley, if not well matured, it is impossible to keep them under any circumstances.

Cultivation for Formation of Onion Sets.

The manner of producing onions for sets is the following: The soil should be of an inferior quality, such as has been run out by constant cropping but should be of such texture as to permit of good cultivation that is it should be easy to work—a poor sandy loam would be preferable. The important thing is to keep the sets from becoming too large, and in order to overcome this, it is advisable to sow fifty five to sixty pounds of seed to the acre.

The seed may be sown as late as the last week in May or the first week in June. By sowing the seed so thick causes the seedlings to be so crowded that it prevents their making a very large growth. In sowing the seed rather a wide drill should be made so that the seed may be spread out sufficiently. If the sets should grow too large these should be picked out and sold for pickling purposes. To prevent the sets from becoming too large, they may be pulled up and

harvested when large enough. As a rule harvesting may be done the early part of August, thus giving ample time for drying off well before fall rains set in, taking care to house them when perfectly dry. The sets may be run through a sieve or screen with about $\frac{1}{4}$ inch mesh. Use only such as will pass through this screen for sets.

PEAS.

In this bulletin only such as have been tested will be discussed. Peas belong to a family of Leguminosæ known scientifically as *pisum sativum* and are thought to be a native of Asia, where they were grown several hundred years B. C. The garden varieties are divided into two classes; the shelling or most common, and the sugar or edible podded, which may be again divided into dwarf or climbing, with seed of each either smoothed or wrinkled. In the United States the shelling varieties are used mostly in the green state. But in Europe they are also used to a great extent in their dry state. The edible podded varieties have a soft, thin pod which may be cooked in a manner similar to the string bean.

Three varieties of peas were grown from seed donated to the station by Atlee Burpee & Co., namely, Hurst's Reliance, Gregory's Surprise and New English Forcing.

Hurst's Reliance proved to be a hardy and strong growing variety, vines when full grown measured from 2 feet to 2 feet 6 inches. It is very productive, pods being well filled with from 6 to 8 peas which are very sweet. This can be highly recommended for a main crop.

Gregory's Surprise is a hardy variety and of a dark green color, growing about 12 inches high and being a little more productive than the Hurst's Reliance. The quality is about the same. The pods are not quite so large, producing from 5 to 7 peas in each. It is an excellent variety owing to its requiring no staking and can be grown closer together between the rows.

New English Forcing.—This is a very dwarf growing pea, the vine being only 8 inches high, producing a good quality of large, well filled pods with from 8 to 9 peas in each pod, of better quality than either Hurst's Reliance or Gregory's Surprise. Below is given in tabulated form the results of the notes taken on the three varieties above mentioned:

Name of Variety.	Date of Sowing	Date of Germinating	Date of Blooming	Date of Edible Maturity	Date of Market Maturity	Date of Maturing
Hurst's Reliance.....	April 17	May 1	June 22	July 4	July 10	July 30
Gregory's Surprise.....	April 18	May 1	June 4	June 20	June 26	June 30
New English Forcing.....	April 17	May 1	June 6	June 24	June 29	June 30

BEANS.

Union Bean No. 4966.—Seed received from the Department at Washington. The variety has been tested for two years in succession and proves to be an excellent one on account of its productiveness and good quality and length of season. It stands the dry season well, and does not become stringy and tough as some others do.

Burpee's Stringless.—This, as the above, gave good satisfaction; is productive and of good quality, pods being quite fleshy and very tender and of an excellent green color, which make it a very desirable market variety.

Burpee's Extra Early Refugee.—A very prolific bean of good quality, well worth its cultivation; ranks very favorably with the best; plants dwarf and close growing.

Burpee's New Willow Leaf Bush Lima.

The great trouble with the Lima bean in this locality and perhaps throughout the Willamette valley, is that it is a very uncertain crop. The last two seasons have matured them very well, but for several seasons before it has been impossible to mature them in time to harvest the crop. This variety is very dwarf growing, being only from about five to six inches high with pods about three inches in length by one inch in width, containing from three to four beans in each pod.

In 1900 seed of the above variety matured on the experimental ground. The seed saved was sown in the spring of 1901 at the same time and in the same row with seed of the same variety sent out by Burpee & Co. of the above year.

This was done in order to test the productiveness and the dates of maturity of these same varieties grown in different climates.

The result was in favor of home-grown seed, plants were stronger, quite a considerable more productive, and matured earlier. In both instances the quality was good.

Burpee's Bush Lima strain of Quarter Century.—This variety made fairly good growth but did not mature much seed. It is not in any way suited to our location. But what seed did mature will be sown this year to see what the outcome will be next fall with home grown seed of this variety.

Buff Bean.—Pod yellow, a good strong growing plant; one of the early varieties. Very productive, ranks favorably with Union and Burpee's New Stringless. Only drawback to it is that the pod is yellow. Those who like the color of pod will find it very suitable owing to its productiveness.

Broad Bean—*Faba vulgaris*.—Several varieties of this bean have been received from the Department of Agriculture, and have given good results, being quite hardy, they can be grown in our climate to good advantage for stock feeding purposes, although the varieties treated upon are mostly used as a vegetable in their green state—never in the dry. That is not to the writer's knowledge though he has been acquainted with them for over half a century.

In order to appreciate them in the young state, a taste must be cultivated for them, as they have a peculiar flavor of their own. In Italy, Germany and England, they are very much grown for table use, also for horse feed, although the smaller variety is generally used for the latter purpose. When used as a vegetable they must never be permitted to become the least matured, although some prefer them even when in half matured condition. When cooked in this latter state the water should be strained off and other hot water be used to finish cooking them; this will take away the rather strong taste. They are mostly cooked with pork or bacon. Do not understand me to cook the pods as in the string beans, but shell the same as peas.

Culture.—This variety of bean should be sown early, say February, and not later than the middle of March, if good results are expected. Owing to the manner in which the roots penetrate the soil, very deep plowing is essential. This will give them an opportunity to throw their long tap root well into the soil, as otherwise they can not do when grown on shallow ground. Sometimes these are grown on soil that needs a change from heavy and continued crops. They should be sown from two to three feet between the rows. This

gives a chance for good cultivation of the soil during the greater part of the summer, serving both as a fallow crop and as a means of growing a good quantity and good quality of food either for hogs or horses. When used for the latter they should be very coarsely chopped, one-half pint per day will have a great effect on the animal, putting fresh life and vigor into him, enabling him to stand the strain of the daily work much better.

The following table gives the results as shown by notes taken:

Name of Variety.	Date of Planting	Date of Germinating	Date of Bloom	Date of Edible Maturity	Date of Marketable Maturity	Date of Maturity
Union	May 4	May 14	July 11	July 17	July 22	August 28
Burpee's Stringless	Sept 30	May 14	July 2	July 12	July 17	August 17
Burpee's Extra Early Refugee	April 26	May 10	July 21	July 28	July 30	August 28
Burpee's Bush Lima, strain of Quarter Cent.	April 30	May 14	July 20	July 30	August 5	Sept. 16
Burpee's New Willow, leaf Bush Lima	April 30	May 14	July 24	August 5	August 10	Sept. 6
Burpee's New Willow, leaf Bush Lima	April 30	May 14	July 8	July 17	July 23	Sept. 6
Buff Bean, Dept. Agri. No. 4984	May 4	May 15	July 11	July 17	July 22	August 28
Broad Bean, No. 4353, variety Secileans	April 13	April 30	July 25	July 10	July 15	August 12
Broad Bean, No. 4358, variety Neapolitan	April 28	May 12	July 7	July 18	July 25	August 12
Broad Bean, No. 4352, variety Servilla long pod	April 28	May 12	July 12	July 25	July 30	August 28
Broad Bean, No. 4351, Aquadulce Improved	April 28	May 7	July 18	August 2	August 8	August 28

Broad Bean—*Faba vulgaris*—Average yield per acre of the varieties of Broad beans; 75.41 bushels, grown 18 inches between the rows or planting 5 rows to rod or 3.3 feet apart the yield was 34.26 bushels.

VEGETABLE MARROW.

This is a half hardy annual, requiring the same cultivation as the pumpkin or squash. Two years ago several varieties of the marrow were received from the Department of Agriculture, the seed having been received from Italy. The plants do not run to vine as do many of the English varieties, such as Moor's Vegetable Cream and the like, but make a compact growth, producing their fruit from the main stem. In most cases the fruit is of a dark green color, often mottled either with white or yellow. Some plants produce marrows from twelve to fifteen inches in length, others round fruit, some being green or white or of a yellowish color, as above, all being smooth instead of having a rough, warty growth like the

summer squash, namely, the crook neck. All varieties of the vegetable marrow are more strictly a summer vegetable, consequently are of no value for winter use as are the squash and pumpkin. The cultivation is in every way the same as for the latter. The vegetable marrow being a summer vegetable, it is desirable to plant seed early in pots or boxes in hotbeds prepared for that purpose, taking care to harden off before planting out in the open ground. This should not be done until all danger of frost is past; previous to setting out, the ground should be well covered with well rotted barnyard manure and plowed under as deeply as can be done. When manure is scarce I have found the following plan answers remarkably well: first dig out a hole twelve or fifteen inches deep and place several shovelfulls of manure into the same, covering the manure over with the soil that has been taken out to the depth of six or eight inches, then set the young plants in a triangular position over the spot where the manure has been deposited. Seed may be planted in the way described for plants. This plan works well on all varieties of the squash family. The following numbered varieties were received from the Department of Agriculture: Nos. 3136, 3134, 3148, 3133, 3132.

There was not enough difference in the growth and production to warrant a separate description. Each packet of seed produced marrows of all shapes and colors, some being quite round and dark green; while others were oval or oblong, some were spotted with white and yellow. The plants were of a compact growth.

BROCCOLI AND CAULIFLOWER.

There is a great deal of misunderstanding regarding the Cauliflower and Broccoli. Both are the same in their general make up and growth, both producing heads in the same manner and to the casual observer are taken one for the other. The difference is that Cauliflower is a more tender variety and therefore will not stand a very low temperature. The seed is sown in early spring and will produce heads during the summer.

The Broccoli will stand a temperature as low as 25 without much injury to the plant. The seed is sown in the spring, the plants set out in June or early part of July and continue to grow until the spring following, some varieties producing heads at intervals during winter and up to as late as May. Attention needs to be directed during the winter to such plants as are about to produce heads. These should have the outer leaves turned over the head to protect it from frost to which it is very susceptible.

The seed may be sown and the plants treated in every way as for the cabbage. They thrive well in a deep, rich soil. Much better results would be had if more attention were given to the matter of deep cultivation, that is, in deep spading or plowing of the ground. Manure that has been well composted should be used plentifully

and plowed in deep. By so doing the roots of the plants are encouraged to penetrate deep into the soil where they can find moisture as well as food. The shallow plowing in of manure has the tendency to keep the feeding roots of plants near the surface and will therefore soon dry out and turn blue, and when once the plants are stricken with the blues no further growth will be made and they might as well be discarded.

Experiments were made in growing the Broccoli for seed production during the years of 1900 and 1901, but the results have not been satisfactory owing to the temperature's falling so low that the tender heads become more or less damaged and as a result failed to produce seed to any considerable extent. I am inclined to think that if the experiment were made in the southern part of the state where the climate is more even that quite a success might be made in the production of seed. As it is, nearly all of our seed has to be imported.

The following varieties of cauliflower are best adapted for early use: Early Snow Ball, Extra Early Erfurt and Early Paris. There are many so-called varieties but the above have proved to be the most reliable on our testing ground. For second early are Burpee's Dry Weather, Lenormand's Short Stem. For fall and early winter Veitche's autumn Giant Broccoli, for succession, as follows: Snow's Winter White, Knight's Self-protecting, Purple Sprouting, Daniels' Mammoth, and the Old French—The Sulphur. The above will be found to mature in the order named.

Seed for extra early planting may be sown in cold frames the first week in October, and the young plants thinned out so that they do not stand too thick in the bed. The frame should be provided with glass lights so that the plants may be protected at will from heavy rains and frost, taking care to give plenty of air at all times. During the winter, plants grown in this manner will be ready to set out early, and are more hardy than those that have been hurried up in a hotbed in early spring.

Plants raised under glass in early spring should be well hardened off before attempting to set out into open ground. For the late varieties, seed may be sown in a bed prepared for that purpose in the open ground. In removing young plants from the seed beds, care should be taken to lift them with all the roots possible. Do not attempt to pull them up. By so doing the greater part of the roots are left in the ground and the plants will be much weakened by it. Broccoli may be treated in the same manner as late Cauliflower.

In concluding this bulletin, I wish to say that it was not written so much for the professional gardener, as for the amateur, the novice, who takes a keen interest in all the little details of the successful growing of his kitchen garden and who desires to grow the best varieties to the very highest state of perfection, without taking into consideration the extra work that such care and cultivation may cause.

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Address JAMES WITHYCOMBE,

Director of Experiment Station, Corvallis, Oregon.

6000.

Bulletin No. 75.

March, 1903.

Department of Entomology and Plant Diseases.

Oregon Agricultural Experiment Station.

CORVALLIS, OREGON.

INSECTICIDES AND FUNGICIDES.

BRIEF DIRECTIONS FOR THEIR PREPARATION AND USE,
INCLUDING SPRAYING, DUSTING, FUMIGATING, ETC.....

By A. B. CORDLEY.

The Bulletins of this Station are sent Free to all Residents of
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INSECTICIDES AND FUNGICIDES.

Brief directions for their preparation and use, including spraying, dusting, fumigating, etc.

INTRODUCTION.

None of the crops of orchard, garden or field; none of our domestic animals; practically none of our food products, household effects or wearing apparel but are subject to the ravages of insects or fungi, or both. Even man, himself, is subject to great personal annoyance and even disease by these ever present agencies.

The financial losses caused by such ravages are enormous. Some years ago, Dr. C. V. Riley, at that time the greatest authority on economic entomology, estimated the average annual loss in the United States from the ravages of insects alone at not less than ten per cent of the total value of all crops grown—a tax upon agriculture much greater than the combined levies for the support of schools and the maintenance of our municipal, county, state and national governments. The estimate is none too high. I have observed that a tax levied by insects or fungi which does not greatly exceed ten per cent of the value of the crop rarely attracts attention. A loss of twenty-five, fifty or seventy-five per cent is necessary to awaken us to a realization of the fact that something is wrong.

Much of this loss can be prevented—the tax levy can be reduced—some of it by proper agricultural practices, some by the selection of resistant varieties of the crops to be grown, some by the intelligent use of insecticides and fungicides.

It is the purpose of this bulletin to give brief directions for the preparation of the most important insecticides and fungicides that have been tested by experiment station workers and found useful, prefacing these directions by such references to the nature of insects and fungi as may be necessary to an understanding of the general principles which underlie the successful use of the various compounds mentioned.

INSECTS AND INSECTICIDES.

To understand the general principle which underlies the selection of the proper remedy to be used for any particular insect, one has only to know that practically all insects may be divided into two great groups.

GROUP I.—This includes all insects that have biting mouth parts—mandibulate insects—and which actually chew and swallow the tissues of the plant or other substance upon which they feed. Grasshoppers, caterpillars, flea-beetles, striped cucumber-beetles, codling moth larvæ, etc., are good examples of this group.

GROUP II.—This includes all insects with beak-like sucking mouth parts—haustellate insects—which pierce the plant or animal upon which they feed and suck up its juices or blood but neither chew nor swallow any of the structural tissues. The apple-tingis, woolly-aphis, hop-louse, green apple-aphis, black cherry-aphis, San Jose Scale, etc., are good examples of this group.

In general, insects which belong to group I may be poisoned by sprinkling or dusting the surface of the plant upon which they feed with some poisonous substance; but insects which belong to group II cannot be so poisoned since they secure their food from beneath the surface and cannot be made to eat the poison. They must be destroyed by gases, washes, or other substances which act externally upon their bodies.

All insecticide substances may therefore be arranged into two general groups.

GROUP I—FOOD POISONS.—This group includes, principally, the various arsenicals, such as Paris green, London purple, Scheele's green, arsenite of soda, arsenate of lead, etc. These poisons are all valuable against insects which belong to group I and feed exposed upon the surface of plants but are practically valueless against those of group II.

GROUP II—CONTACT INSECTICIDES.—This group includes a great variety of substances which act externally upon the bodies of insects either as mechanical irritants or caustics, or to smother them by closing their breathing pores, or to fill the air about them with poisonous gases, or simply as repellants. Soap, sulphur, tobacco, insect powder, hellebore, kerosene, kerosene emulsions, crude petroleum, the lime-sulphur-salt wash, resin washes, hydrocyanic acid gas, and carbon bisulphide are some of the most valuable insecti-

cides of this group. These are used successfully not only against sucking insects but many of them are also used against biting insects when for any reason it is undesirable to use poisons; or when it is impossible to apply poisons directly to the food supply, as in the case of insects which work beneath the surface of the soil, or as borers or miners in wood, leaf or fruit, or in stored products, or as animal parasites, or household pests.

FUNGI AND FUNGICIDES.

A fungus is a plant as truly as is the apple tree, the prune tree, the wheat plant or any other plant upon which it may be growing. It differs from the common plants essentially in being much more simple in structure and in being devoid of chlorophyll—the green coloring matter of plants. Its seeds, which are called spores, are more simple and very much smaller than the smallest seeds of our common plants and are produced in almost inconceivably great numbers. The vegetative portion of the fungus, the part which, in a sense, corresponds to the roots, stems and leaves of ordinary plants, the part which absorbs the food materials and eventually produces the spores, consists of a mass of more or less branched, white or colorless, and very minute threads and is called the mycelium.

Being so small and light, the spores are readily carried long distances by the wind, are washed about by the rains, and are also carried by birds and insects and probably by other agencies. These agencies are thus largely responsible for the spread of fungus diseases from leaf to leaf, plant to plant, or orchard to orchard. Over greater distances the spores may be carried on shipments of infested nursery stock, fresh fruits, vegetables, seeds, etc.

Should a spore fall upon suitable soil, such as the surface of leaf or fruit, and the conditions of heat and moisture be favorable, it will germinate—push out a delicate, slender germ-tube. In the case of most parasitic fungi this germ-tube soon penetrates the epidermis of the leaf or fruit and the mycelium develops in the underlying tissues entirely beyond the reach of fungicides. In some cases, however, the mycelium spreads over the surface of the plant. In other words, fungi, like insects, may be divided into two groups, as follows:

GROUP I—INTERNAL FUNGI.—This includes those fungi in which the germ-tube penetrates the skin of leaf, fruit, branch or root and

the mycelium develops entirely within the tissues of the host plant. Apple-tree anthracnose, brown-rot, the grain-smuts and rusts, the downy-mildews, for all practical purposes apple-scab, and many others may be included in this group. The philosophy of spraying for this group of fungus diseases is based upon the fact that they cannot be cured, but can be prevented. The germ-tube must be destroyed before it penetrates the epidermis and to do this the surface of the host must be thoroughly protected by the fungicide during the entire time the spores are germinating.

GROUP II—EXTERNAL FUNGI.—This includes those fungi in which the mycelium spreads over the surface of the host. This group includes but comparatively few serious pests. Perhaps the one that has attracted most attention in this state is the powdery-mildew of gooseberries. The powdery-mildews of the grape and of the rose also belong to this group. These diseases may be prevented by proper fungicidal treatment the same as diseases of group I and in addition they may also be cured by such treatment. The mycelium being exposed upon the surface of the host may be reached and killed by the proper fungicides.

INSECTICIDES.

GROUP I—FOOD POISONS.

1. PARIS GREEN.

This is used more extensively than any other poison. It has largely supplanted London purple but is, in turn, being supplanted by various other compounds of arsenic. Pure, it is among the most reliable of insecticides but has the disadvantage that it is a rather coarse crystalline substance which settles rapidly to the bottom of the spray-tank unless the contents are kept thoroughly stirred. For codling moth, bud moth, tent caterpillars and many other insects of group I it is generally used as a spray in the following proportions:

Paris green.....	1 pound
Quick lime.....	2 pounds
Water.....	160-200 gallons

Slake the lime, stir the poison into a thin paste with a little water, then strain the mixture through a sieve into a tank containing the required amount of water. If it is desired to spray for both fungi and insects, Bordeaux mixture (22 or 23) may be used in place of the water in the above formula. For peach or other tender foliage 300 gallons of water or Bordeaux should be used. *It is necessary to keep this mixture well stirred while spraying.*

Owing to the excessive cost of Paris green and the difficulty of keeping it in suspension in the liquid, various other compounds of white arsenic—arsenious acid—are now extensively used in its place. In solution, arsenic is extremely injurious to foliage. It is, therefore, necessary that it be combined with other substances which will prevent the injury. Of these combinations, I have had the best results with the lime-arsenic-soda or Kedzie mixture which was first recommended by Dr. R. C. Kedzie of the Michigan experiment station. It is prepared as follows:

2. ARSENITE OF SODA.

White arsenic.....	1 pound
Sal soda.....	4 to 5 pounds
Water.....	2 gallons

Boil together 15 minutes, or until a clear solution is formed. This stock solution may be placed in jars, *labeled poison*, and kept indefinitely. Use from 1 to 1½ quarts of this stock solution and 4 to 6 pounds of freshly slaked lime to each 50 gallons of water. Bordeaux mixture (22 or 23) may be used to advantage in place of the water whenever it is desired to use a combined insecticide and fungicide.

Another method of using white arsenic is as follows:

3. ARSENITE OF LIME.

White arsenic.....	1 pound
Quick lime.....	2 pounds
Water.....	2 gallons

Slake the lime and then boil the ingredients together for an hour. For use, dilute with 300-400 gallons of Bordeaux mixture (22 or 23). I have used this formula successfully but find that in this climate injury to the foliage is very likely to occur unless great care be exercised in its preparation.

4. ARSENATE OF LEAD.

Arsenate of soda.....	4 ounces
Acetate of lead.....	11 ounces
Water.....	25 to 150 gallons

Dissolve the arsenate of soda in two quarts and the acetate of lead in four quarts, of warm water. When dissolved add them to the 150 gallons of water. This formula is especially valuable for spraying very delicate foliage or for use against insects which are killed only by large amounts of poison, since it can be used upon plants in much stronger solutions than the other food poisons without injury to the foliage.

DUSTING OR DUST SPRAYING.

It is often convenient to apply poisons by dusting. Dry Paris green may be so applied either pure or adulterated with various substances. If used pure it should be dusted from a cloth sack of suitable texture and only the faintest trace of the poison should appear upon the plants treated. 1 or 2 pounds should be sufficient to treat an acre of any low-growing crop.

To avoid using excessive and dangerous amounts of the poison it is usual to adulterate it as follows:

5. PARIS GREEN. (FOR DUSTING.)

Paris green.....1 pound
 Wheat flour or finely slaked quick lime....25-50 pounds.

Mix the ingredients thoroughly and dust until the plants show a faint trace of white. For dusting only a few plants use a perforated tin can or other sifter. To cover a large acreage use one of the "dust sprayers" which are on the market.

The so-called "dust spray" for orchard trees is prepared as follows:

6. PARIS GREEN (FOR DUST SPRAYING.)

Paris green.....1 pound
 Quick lime.....10 pounds
 Water.....3 quarts

Use the water to slake the lime into a very fine dry powder. Add the poison and mix thoroughly. This dust is blown into the air in a cloud by the use of "dust sprayers" and settles upon foliage and fruit. Dust spraying is much cheaper than spraying with liquids, but results so far obtained indicate that it is less effective for most purposes. All dusting should be done early in the morning while the foliage is yet wet with dew.

POISONED BAITS.

Grasshoppers, cut-worms and a few other pests may be destroyed by poisoned baits. These are prepared in various ways. Small bundles of green, succulent vegetation, dipped in a strong solution of any of the above poisons and scattered about the infested field or garden will prove exceedingly tempting to cut-worms, particularly if the field was plowed in early spring and is free from vegetation. Such baits are most effective if used in spring just before the crop to be protected comes up. Poisoned slices of potato or some similar vegetable are used to poison sow-bugs and wire-worms. Cultivated trees and vines may be successfully protected against the ravages of grasshoppers by use of the so-called bran-arsenic-mash, which is made as follows:

7. BRAN-ARSENIC-MASH.

White arsenic.....1 pound
 Brown sugar.....1 to 2 pounds
 Bran.....6 pounds

Mix the ingredients thoroughly, then add enough water to make a wet wash. A spoonful should be placed at the base of each tree

or vine. For cut-worms a still better bait may be prepared by mixing thoroughly Paris green, bran and middlings as follows:

8. PARIS GREEN (DRY BAIT.)

Paris green.....	1 pound
Middlings.....	15 pounds
Bran.....	15 pounds

This may be sown broadcast upon the vegetation about the borders of cultivated fields or gardens; or by use of a seed drill it may be sown along the rows of plants to be protected. So used it has been found especially valuable for destroying cut-worms in onion fields.

9. GREEN ARSENOID.

Green arsenoid is very similar to Paris green, both in appearance and in insecticide properties. It has the valuable properties of Paris green and is cheaper and more finely divided. It is, therefore, more easily prevented from settling to the bottom of the spray-tank and is more easily distributed as a dust spray. It can be substituted for Paris green in any of the above formulas in which the latter is used.

GROUP II--CONTACT INSECTICIDES.

10. LIME, SULPHUR AND SALT

The lime, sulphur and salt wash is one of the most satisfactory sprays for San Jose scale and is also of value as a fungicide. It is primarily a winter spray but when much reduced in strength has been used to advantage as a summer spray for San Jose scale. Several methods of preparing it are recommended but the following, known as the Oregon formula, is probably the most satisfactory in this climate:

Quick lime.....	50 pounds
Sulphur.....	50 pounds
Salt.....	50 pounds
Water.....	150 gallons

Slake the lime thoroughly, add the sulphur, cover with water, and boil briskly for at least an hour. Then add the salt and boil 15 or 20 minutes longer. Add water to make 150 gallons. Apply with considerable force through a coarse nozzle while still warm. The results of a number of experiments indicate that the salt adds nothing to the efficiency of this spray.

11. LIME, SULPHUR AND COPPER SULPHATE.

Copper sulphate is sometimes used in place of the salt in the formula, which is then as follows:

Lime.....	50 pounds
Sulphur.....	50 pounds
Copper sulphate.....	8 to 10 pounds
Water.....	150 gallons

This is prepared in the same manner as No. 10, is equally effective as a remedy for San Jose scale and may be slightly more efficient as a fungicide. Further experiments are necessary to determine whether the salt or the copper sulphate add anything to the efficiency of these sprays.

12. WHALE-OIL SOAP AND QUASSIA.

Strong soap suds made from any good soap are useful for destroying soft-bodied insects like plant-lice. It is usual, however, to employ for this purpose special soaps made with fish-oils and sold as whale-oil soaps. These vary considerably in composition, some being made with soda, others with potash lye. The latter are much superior and buyers should insist on having potash soaps.

For scale-insects, whale-oil soap is sometimes used in as concentrated a solution as two pounds of soap to one gallon of water, but only upon dormant plants. As a remedy for the various plant-lice one pound of soap to 8 or 10 gallons of water is usually sufficient. Hop growers are inclined to believe that better results are obtained, when spraying for hop-lice, by adding some quassia decoction to the soap solution, as follows:

Whale-oil soap.....	10 pounds
Quassia.....	5 pounds
Water.....	100 gallons

Place the quassia chips in a sack, cover with 8 or 10 gallons of water and soak 12 to 24 hours. Then bring to a boil, remove the chips, add the soap and boil until it is dissolved. Add water to make 100 gallons. If preferred the grower may prepare his own whale-oil soap after the following formula:

Potash lye.....	1 pound
Fish-oil.....	3 pints
Water.....	2 gallons

Dissolve the lye in the water. When boiling hot add the oil and boil about two hours. Add water to make two gallons. Each pound of the soap thus made should be dissolved in 8 or 10 gallons

of water. It will be found a satisfactory remedy for hop-lice and other soft-bodied insects.

13. KEROSENE EMULSION.

Kerosene oil, or coal oil, is a powerful insecticide. The undiluted oil is, however, liable to seriously injure plants to which it is applied. This difficulty is overcome by using one of the special spray pumps which have been devised for the purpose of mixing the oil with water in any desired proportion; or by forming an emulsion with some substance that may be readily diluted with water. Soap is most commonly used for this purpose, as follows:

Kerosene oil	2 gallons
Hard soap (preferably whale-oil)	$\frac{1}{4}$ pound
Water	1 gallon

Dissolve the soap in the water by boiling. Add the suds, boiling hot, to the oil. Churn the mixture violently with a spray pump until it becomes a thick creamy mass. If perfectly emulsified, the oil will not rise to the surface even after standing an indefinite time. Such an emulsion may be used immediately or may be kept as a stock mixture. Before using, dilute one part of the stock emulsion with 8 or 10 parts of water.

This will be found to be an efficient remedy for green-aphis, woolly-aphis, red-spider, mealy-bugs, and certain scale-insects.

14. RESIN WASH.

This is a favorite spray in California for several of the scales infesting citrus fruits. In this state its chief value is as a spray for the various kinds of plant-lice. For this purpose, it may be used as a substitute for kerosene emulsion or whale-oil soap with good results, particularly in the dry summer months. It can also be used as a summer spray for San Jose scale, but we do not advise such use since summer sprays for this pest are less efficient than the winter spray of lime, sulphur and salt. The resin wash may be made as follows:

Resin	20 pounds
Concentrated lye	4 pounds
Fish-oil	2 $\frac{1}{2}$ pints
Water	100 gallons

Place the resin, lye and oil in a kettle with sufficient water to cover them to a depth of three or four inches. Boil about two hours, making occasional additions of water, or until the compound

resembles very strong black coffee. Dilute to one-third the final bulk with hot water, or with cold water added slowly over the fire, making a stock mixture which must be diluted to the full amount of 100 gallons when ready for use.

One gallon of resin wash to each three gallons of Paris green spray No. 1, or Bordeaux mixture No. 22, may be used advantageously to cause the latter to adhere better to smooth leaves.

15. CARBOLIC ACID EMULSION.

Carbolic acid emulsion is used to destroy the eggs and the young maggots which infest radishes, onions and similar garden crops; and occasionally for other insects:

Crude carbolic acid	1 pint
Hard soap	1 pound
Water	1 gallon

Dissolve the soap in boiling water; add the acid and churn as for kerosene emulsion. Use 1 part of emulsion to 30 parts of water.

16. TOBACCO.

The tobacco waste from cigar factories is of considerable value as an insecticide. In greenhouses, it may be used to destroy plant-lice by simply spreading the waste two or three inches deep over the pipes under the benches, or by burning about $\frac{1}{2}$ pound of moist waste to each 500 square feet of glass. Worked into the soil about young apple trees in the orchard or nursery, it is one of the best remedies for the root form of woolly-aphis. A strong decoction, made by a prolonged steeping of a quantity of stems in enough water to cover them and diluting the liquid to the color of strong tea, is often used as a spray for plant-lice. A still better method is as follows:

Hard soap (preferably whale-oil)	1 pound
Water	8 to 10 gallons
Strong tobacco decoction	1 gallon

Dissolve the soap in boiling water, add the tobacco decoction and dilute to 8 to 10 gallons.

17. HELLEBORE.

Powdered hellebore, if fresh, is of value for poisoning insects which are injuring small fruits or vegetables which are nearly ready for market and on which it is undesirable to use the arsenical poisons. It may be dusted over the plants when they are moist with dew, or may be used as a spray in the following proportions:

Hellebore.....	1 ounce
Water.....	2 gallons

18. PYRETHRUM OR INSECT POWDER.

Fresh pyrethrum powder is a valuable remedy for flies, mosquitoes, roaches, ants, fleas and other household pests. It is destructive to insects but not poisonous to the higher animals or to man. It should be kept in an air tight receptacle. The dry powder may be dusted over the floors, or in the hair of dogs infested with fleas, or about their sleeping quarters; or in other places where noxious insects congregate. It may also be used as a spray in conservatories or on a few plants in the garden, in the following proportion:

Pyrethrum.....	1 ounce
Water.....	2 gallons

It is also stated that the flies and mosquitoes in a room may be destroyed by burning a little pyrethrum powder upon some live coals.

19. BISULPHIDE OF CARBON.

Bisulphide of carbon is a colorless liquid with a very disagreeable odor. It is very volatile and its fumes are poisonous to animal and plant life. When mixed with air in the proper proportion they are also very explosive. As an insecticide, it is valuable mainly as a remedy for subterranean insects, borers, or insects infesting stored grains, seeds, etc., and for fumigating buildings which are infested with noxious insects. It is also used extensively for destroying various burrowing animals whose burrows incline downward into the earth. For this purpose pour 2 or 3 ounces of the liquid upon a ball of rags, or other absorbant, place this well down into the burrow and close the opening. Thus used it is an effective remedy for "digger squirrels" and "prairie dogs;" but is not effective against moles and pocket gophers which construct long horizontal burrows. Troublesome ants nests may be destroyed by making a hole in the centre of each nest and pouring into it 2 or 3 ounces of the liquid, after which the hole should be tightly closed. For destroying the root form of woolly-aphis of the apple, it is common to make several holes each 6 to 12 inches deep about the tree and pour 1 or 2 ounces of the liquid into each hole, which should be immediately closed.

Borers in the roots of peach or prune trees may be destroyed by simply pouring from 1 to 3 ounces of the liquid, according to the

size of the tree, about the base of the tree. If the soil is wet or compact, it is best, first, to excavate a shallow trough about the tree and fill this with loose soil before applying the chemical.

For fumigating grains, seeds, storehouses and other buildings, including houses, for the destruction of insects, one pint of the liquid is used for each ton of grain or 1000 cubic feet of space. The building, bin or other receptacle should be tightly closed and kept closed 24 to 36 hours. *During this time no person should attempt to enter the building, nor should any light be allowed inside, until it has been thoroughly ventilated, since the fumes are both poisonous and explosive.*

20. HYDROCYANIC ACID GAS.

This is an extremely poisonous gas which is used in this state principally to fumigate nursery stock. In California it is used to fumigate citrus trees which are infested with scale insects. It has also been used in the east to fumigate scale-infested deciduous fruit trees. Although very efficient the process is so much more expensive than spraying that I do not recommend its use in this state.

Many nurseries now have specially prepared houses, or fumigatoriums, in which to fumigate infested stock. For dormant stock the chemicals are used in the following proportions, for each 100 cubic feet of space inclosed:

Cyanide of potassium (98 per cent)	1 ounce
Sulphuric acid	1 ounce
Water	2 ounces

Place the water in an earthenware or wooden receptacle, add the acid and when all is ready drop in the cyanide of potassium, close the door and keep it closed for at least 40 minutes. Do not attempt to re-enter the house until it has been thoroughly ventilated.

Greenhouses may be fumigated to destroy plant-lice, mealy-bugs, slugs, millipedes, etc., by using the above formula for each 350 cubic feet of space, and keeping the house tightly closed for 15 or 20 minutes. Previous arrangements should be made for opening the ventilators from the outside.

FUNGICIDES.

21. BORDEAUX MIXTURE FOR DORMANT PLANTS.

Bordeaux mixture is perhaps the most generally useful of all spraying compounds. It is the principal remedy for fungus diseases, is of some value as an insecticide, has a beneficial effect upon plants independent of its effect upon their insect and fungus parasites and may be used for most purposes in place of water in the preparation of the arsenical sprays Nos. 1 to 4.

Bordeaux for winter use may be made as follows:

Copper sulphate.....	6 pounds
Quick lime.....	6 pounds
Water	50 gallons

This is known as the 6-6-50 formula. It should be used only upon dormant trees.

22. BORDEAUX MIXTURE FOR PLANTS IN FOLIAGE.

When the trees are in leaf the following 4-6-50 formula is used:

Copper sulphate.....	4 pounds
Quick lime.....	6 pounds
Water	50 gallons

23. BORDEAUX MIXTURE FOR PEACH AND OTHER TENDER PLANTS.

For spraying peach foliage it is best to use the still weaker 3-6-50 formula:

Copper sulphate.....	3 pounds
Quick lime.....	6 pounds
Water	50 gallons

To prepare Bordeaux mixture dissolve the copper sulphate in hot or cold water in a wooden or earthen vessel. Slake the lime, using only sufficient water to insure slaking. The lime should not be allowed to become dry while slaking nor should it be submerged in water. After the lime is slaked add water and stir until the "milk of lime" is of the consistency of cream. The best results are obtained by diluting the milk of lime and the copper sulphate solution each to 25 gallons and then pouring these two dilute solutions together. The lime solution should always be strained through a sieve to exclude particles that might clog the nozzles. A brass

wire sieve, 20 mesh, large enough to fit the head of a barrel or the opening into the spray-tank will prove a great convenience.

When large quantities of Bordeaux are required, it is most convenient to make stock solutions of lime and of copper sulphate of known strength. A convenient stock solution of copper sulphate is made by dissolving 100 pounds in 50 gallons of water; one of lime, by slaking 100 pounds and diluting with water to 50 gallons. Each gallon of the stock solution will then contain 2 pounds of lime or of copper sulphate and the amount to be used in preparing any quantity of Bordeaux according to the above formulas can be readily computed.

If sufficient lime has not been used, or if that used was of an inferior quality the Bordeaux may injure the foliage or may cause a "russetting" of the fruit. It is, therefore, always best to determine whether enough lime has been used by testing the mixture.

TESTING BORDEAUX.

There are three simple tests which may be used. First, hold a clean bright knife blade in the Bordeaux, for at least one minute. If it becomes copper-plated more lime should be used. Second, pour some of the Bordeaux into a shallow dish and holding it up to the light blow gently across its surface. If properly made a thin pellicle will form on the surface of the liquid. If this does not form more lime should be added. Third, dissolve one ounce of ferrocyanide of potassium in 5 or 6 ounces of water. Pour some of the Bordeaux into a white dish and add to it a few drops of the ferrocyanide solution. If sufficient lime has been used no change will be noticed. If a brownish-red discoloration takes place more lime should be added.

One gallon of Resin wash No. 14 to three gallons of Bordeaux is said to make the mixture more adhesive.

24. COPPER SULPHATE SOLUTION.

A simple solution of copper sulphate is used as a remedy for grain smuts and sometimes as a spray in place of Bordeaux. For dormant trees use

Copper sulphate	1 pound
Water	25 gallons

For trees in foliage use

Copper sulphate	1 pound
Water	250 gallons

For smut of wheat or oats, soak the seed for 10 to 12 hours in a solution of one pound of blue vitriol to 25 gallons of water, then put the seed for 5 or 10 minutes into lime water made by slaking one pound of lime and diluting it with 10 gallons of water.

The treatment with lime water tends to prevent the copper sulphate solution from injuring the seed, but many farmers omit that part of the treatment.

Bordeaux mixture has the disadvantage that it produces an unsightly deposit upon foliage, blossoms and fruit and hence can not well be used upon florists' plants or upon fruits nearly ready for market. For use under such conditions the ammoniacal copper carbonate, the simple copper carbonate mixture or the copper acetate solution is recommended.

25. AMMONIACAL COPPER CARBONATE.

Copper carbonate	5 ounces
Strong ammonia	3 pints
Water	50 gallons

Mix the copper carbonate into a paste with a little water, add the ammonia and when the copper carbonate is completely dissolved pour the resulting deep blue liquid into the water.

26. COPPER CARBONATE MIXTURE.

Copper carbonate	1 pound
Water	50 gallons

Mix the copper carbonate into a paste with a little water before attempting to add it to the 50 gallons.

27. COPPER ACETATE SOLUTION.

Dibasic acetate of copper	6 ounces
Water	50 gallons

Use finely powdered acetate of copper, mix it into a paste with a little water, then dilute with the full amount of water.

28. POTASSIUM SULPHIDE SOLUTION.

Potassium sulphide	1 ounce
Water	2 to 3 gallons

Dissolve the potassium sulphide in the water.

Valuable as a spray for mildews.

29. CORROSIVE SUBLIMATE.

Corrosive sublimate	1 ounce
Water	7 to 8 gallons

This is valuable as a preventive of potato scab. In a wooden vessel, dissolve the poison in one gallon of water, then dilute to the full amount. Place the scabby seed potatoes in a sack, immerse them in the solution and allow them to soak 1 to 2 hours. The solution and the treated potatoes are extremely poisonous.

30. FORMALIN.

Formalin, a 40 per cent solution of formaldehyde gas in water, is being used extensively as a preventive of potato-scab and of the grain-smuts, and gives most excellent results. It is cheap, efficient and non-poisonous. For potato-scab, soak the seed 2 hours in the following solution:

Formalin	$\frac{1}{2}$ pint
Water.....	15 gallons

For grain-smuts soak the seed for 1 to 2 hours in the following:

Formalin	1 pint
Water.....	50 gallons



METHODS OF TREATMENT FOR INSECT PESTS AND PLANT DISEASES.

APPLE.—For apple-scab, spray with 22; first, when fruit buds are swelling; second, when blossoms are unfolding; third, after petals fall; and thereafter every 10 days or two weeks as long as wet weather persists. For codling moth, add Paris green or one of the arsenic sprays to the Bordeaux for the third and subsequent applications; then begin late in June and spray every two weeks with 1 or 2 until three weeks before the fruit is to be picked. If trees are infested with San Jose scale spray with 10 or 11 when trees are dormant. For green-aphis, use 13, as soon as leaf buds start and repeat whenever the aphid becomes abundant on the foliage. For woolly-aphis, branch-form, use 13; for root-form, use 16 or 19. For tingis, spray with 13 when eggs are hatching and practice *clean* culture. For apple-tree anthracnose, spray as soon as possible after crop is gathered with 21 and repeat in two weeks; write for bulletin No. 60.

BARLEY.—To prevent smut, use 30.

BEAN.—For anthracnose, soak seed in 30; when plants are two or three inches high spray with 22 and repeat two or three times at intervals of 10 or 12 days. For weevil, fumigate seed with 19.

BEE.—See under Sugar Bee.

BLACKBERRY.—For anthracnose, leaf spot and rust spray with 21, before leaves start; when leaves are half grown use 22; repeat in two weeks.

CABBAGE AND CAULIFLOWER.—For club-root, rotate crops; destroy all stumps and other waste in fall; apply lime at rate of 80 to 100 bushels per acre and work into soil. For worms, use 1 or 5 when first observed. After plants head, 17 or 18 may be used if preferred. For aphid, use 12 or 13.

CARNATIONS.—For rust and other fungus diseases, spray with 22, when disease first appears and repeat at intervals of two weeks. For red spider or aphid use 12 or 13.

CELERY.—For leaf-spot or leaf-blight use 22 upon young seedlings and repeat two or three times at intervals of two weeks.

CHERRY.—For brown-rot and leaf-spot, spray with 22 when blossoms are opening and again when petals fall; after fruit begins to

color use 25, 26 or 27. For slugs, use 1 when slugs first appear, or if fruit is ripening dust with air-slaked lime or fine dry dust. For aphids, use 12 or 13. For gummosis, cut out gum pockets, slit outer bark from branches to ground and wash or spray with 21. For San Jose scale use 10 or 11 when trees are dormant.

CHRYSANTHEMUM.—For leaf-spot spray with 22 and repeat once or twice at intervals of two weeks if necessary.

CUCUMBER.—For striped cucumber-beetle, dust the plants with 5, or spray with 22. Plant some early squash as trap plants and when the beetles are feeding on them dust them with pure Paris green. For fungus diseases, spray with 22 when vines begin to form and repeat three or four times at intervals of 2 weeks.

CURRENT.—For mildew, spray with 28, when buds begin to open and repeat at intervals of 10 to 15 days until fruit is nearly ripe. For worms on leaves, use 1 or 17. For fruit worms, destroy infested fruit; allow the poultry the run of the bushes when infested fruit is falling.

GOOSEBERRY.—Same as currant.

GRAPE.—For mildews, rot and anthracnose, spray with 22 when buds are swelling, when leaves are half grown, just before blossoming, when fruit has set, and repeat once or twice at intervals of two weeks. If later applications are required use 25.

HOP.—For hop-lice, spray with 12 *when lice first appear* and repeat as necessary.

HOUSEHOLD PESTS.—For fleas, flies, mosquitoes, roaches, etc., use 18. Garments infested with clothes moths may be inclosed in tight box and fumigated with 19. If house is badly infested with any insect pest fumigate with 19.

MUSKMELON.—For striped cucumber-beetle, see under cucumber. For anthracnose, mildew and leaf-blight, use 22 when vines begin to form and repeat 2 or 3 times at intervals of 2 weeks.

NURSERY STOCK.—For various fungus diseases, spray with 22 when leaves first appear and repeat at intervals of 10 to 15 days until rainy season closes. Fumigate with 20.

OATS.—For loose smut, soak seed in 30 or 24.

ONIONS.—For smut, practice rotation of crops; transplanting seedlings; use 100 pounds of sulphur and 50 pounds of air-slaked lime per acre in the drills with the seed. For powdery-mildew, try 22 when disease first appears and repeat if necessary. For cut worms use 8.

PEA.—For mildew, spray with 22 or 28 when mildew appears and repeat once or twice, if necessary, at intervals of 10 days.

PEACH.—For leaf-curl, spray before buds swell with 10, 11 or 21; as buds are opening use 23; repeat when calyx drops. For pustular spot, brown-rot, or scab make one or two additional applications at intervals of two weeks. If brown-rot is severe follow with one or two applications of 27 while fruit is coloring. For San Jose scale, apply 10 or 11 while trees are dormant. For twig-borer use 10 just before buds swell. For root-borers, as a preventive wrap base of trunks with paper or cloth or paint them with poisoned whitewash; to kill borers dig them out in fall and spring, or use 19.

PEAR.—For scab, codling moth and San Jose scale see under apple. For slug, see under cherry. For pear blight cut out and burn all diseased branches. Make cut several inches below where disease extends and sterilize tools frequently by dipping in 29. Paint cut surfaces with 21, strong.

PLUM AND PRUNE.—For twig-borer and root-borer see under peach. For leaf-curl give good drainage, good cultivation and grow leguminous cover crops in winter. For brown-rot see under cherry.

POTATO.—For scab, soak seed potatoes in 30 or 29. For potato dry-rot, or blight, spray with 22 when plants are 6 inches high and repeat two or three times at intervals of two weeks. For flea-beetles, spray with one of the food poisons, 1, 2 or 3 in 22, whenever they appear. For wet-rot, plant only sound seed, practice rotation of crops, destroy blighted plants as fast as they appear and spray to prevent flea-beetle punctures.

QUINCE.—For leaf and fruit-spot, spray with 22 when blossom buds begin to open; again when fruit has set and repeat at intervals of two weeks until rainy season is over.

RASPBERRY.—See under blackberry.

ROSE.—For mildew spray with 28 whenever it appears. For leaf-spot spray with 22 or 25 when spots first appear and repeat as necessary. For aphid use 12 or 13, or wash them off with a stream of water from the garden hose. For rust, burn fallen leaves in fall; spray with 21 before buds start in spring; repeat the applications, using 25 or 26, at intervals of 10 to 15 days.

STRAWBERRY.—For crown-miner and root-borer destroy infested plants before May 1. For leaf-roller burn tops as soon as possible after crop is gathered. For leaf-blight spray with 22 when new

leaves start and repeat every 10 to 15 days until blooms appear. Mow and burn tops as for leaf-roller.

SUGAR BEET.—For leaf-spot or flea-beetles spray with 22 when spots or beetles first appear and repeat two or three times at intervals of two weeks. For cut-worms, if bad, use 8. For aphids use 12 or 13, or an abundance of very fine dust.

TOMATO.—For rot or blight use 22 when disease first appears. Repeat once or twice, if necessary, at intervals of 10 to 15 days. For flea-beetles spray with 22 when they appear or hang papers from a string stretched just over the plants.

VIOLET.—For blight, use 22 or 25 when it first appears. Repeat once or twice at intervals of 10 to 15 days, if necessary.

WATERMELON.—See muskmelon.

WHEAT.—For smut soak seed in 30 or 24. For Hessian fly practice late seeding. For insects in stored grain use 19.

A. B. CORDLEY.

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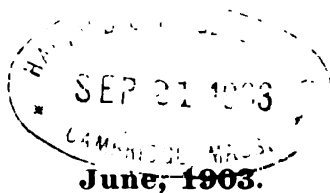
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Address JAMES WITHYCOMBE,
Director of Experiment Station, Corvallis, Oregon.

6000.



Bulletin No. 76.

AGRICULTURAL DEPARTMENT.

Oregon Agricultural Experiment Station.

CORVALLIS, OREGON.

LEGUMINOUS FORAGE PLANTS.

THE BULLETINS OF THIS STATION ARE SENT FREE TO ALL RESIDENTS
OF OREGON WHO REQUEST THEM.

AGRICULTURAL COLLEGE PRINTING OFFICE.
GEO. B. KRAZY, PRINTER.
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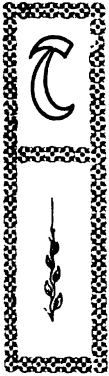
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Leguminous Forage Plants.

BY JAMES WITHYCOMBE.

INTRODUCTION.



THE purpose of this bulletin is to supply the popular demand for information relative to the growing of leguminous forage plants.

The legumes are selected for two general reasons. First, on account of the value of this class of plants in furnishing protein compounds economically, and second, the beneficial influence exerted on the soil both chemically and physically as the result of their growth.

Owing to the fact that the State is divided into two grand physical divisions by the Cascade range of mountains, known as Eastern and Western Oregon, there is a very wide variation in the conditions under which forage plants are grown in this State. These districts possess a great diversity of soils, ranging from a volcanic ash to a heavy clay. The climatic conditions are equally as variable, ranging in annual precipitation from about seven inches to over one hundred inches, and from equable winter temperatures to those that are exceedingly rigorous.

Thus it will be readily seen that no general arbitrary rule can be successfully followed in the methods of seeding and the culture of forage plants under such variable conditions of climate and soil. The agriculturist will necessarily have to work out in a large measure for himself the details relative to the selection of varieties and cultural methods that are best suited to his particular soil and climate.

Each physical division supports in a measure forage plants peculiar to itself. For instance, conditions in Western Oregon are favorable for the growing of the clovers and vetch. While in the eastern section alfalfa is the principal domestic forage plant. Only restricted areas in this section will support clover without irrigation, while practically the whole of the western portion of the state is well adapted to this plant.

RED CLOVER (*Trifolium pratense*)

Red clover is easily the most valuable forage plant grown in Western Oregon. This section is the home of the clover judging from the large number of native varieties found here, of which there are at least seventeen.

The season of growth for clover throughout the larger portion of the Willamette valley extends from about the middle of March to the first of December, thus making it a valuable pasture as well as hay crop. Climatic conditions are not exactly suited to the operations of successful hay making when the plant is permitted to develop under normal conditions. The clover crop ordinarily is ready for hay from the first to the fifteenth of June, and quite frequently about this time refreshing showers are very prevalent. These showers are exceedingly helpful to other agricultural crops but are responsible oftentimes for a serious damage to clover hay. This damage consists of marked discoloration of the hay and occasionally an appreciable loss of protein substances. This may be obviated by pasturing clover off in the Spring, or by cutting the first crop for the silo when the blossoms appear. By the first method the hay crop is deferred to July and by the second to about August, thus improving the chances of good weather for the curing of the hay crop.

At this Station last season the first cutting for the silo was commenced June 11th and completed June 14th. The crop averaged 12.52 tons of green clover per acre. The second crop was cut July 25th, yielding 1.50 tons of cured hay per acre. There was also a good third growth which was pastured off with sheep. The latest period it would be safe to pasture clover for a deferred hay crop must be governed by the stand, the vigor of the plants, soil moisture and general conditions for growth. Ordinarily in Western Oregon it can be pastured as late as the first of May.

Continuous cropping with the cereals has materially changed the texture and hence reduced the productiveness of the valley soils. In their original state they were friable and rather easily worked, while at present, owing to a lessening of the per centum of vegetable matter present, these soils are heavy, lifeless and have a strong tendency to become cloddy, consequently are hard to work. The growing of clover, however, as a rotation crop will correct this evil. It is estimated that the roots of clover will about equal the weight of the

cured hay, so that from a crop of three or four tons of hay per acre we have an equal weight of roots left in the soil, which will not only very perceptibly improve the texture of the latter but also materially increase the amount of available plant food for succeeding crops.

Clover as a fertilizer is scarcely surpassed by any other plant, for as is generally well known, like all other legumes, it has the power to appropriate atmospheric nitrogen. Thus it takes direct from the air the most valuable element of plant food. However, we must not lose sight of the fact that clover also takes from the soil valuable elements of fertility in the form of potash and phosphates. Hence, if large crops of clover hay are taken from the land without adequate returns being made, these latter elements may in time be seriously diminished. To prevent this, the clover hay grown upon the farm should be consumed by domestic live stock maintained on the farm and the manure resulting therefrom returned to the land, thus preserving the productivity of the soil almost indefinitely.

Although Western Oregon is so well adapted to the growing of clover, numerous failures are annually recorded. This is very largely due to faulty methods of seeding. In fact these failures were so general in the past it was popularly believed that clover could not be successfully grown upon the ordinary prairie soils of the valley. The fallacy of this, however, has been completely proven within the past few years.

There is often some difficulty experienced in securing a satisfactory stand of clover on land that has been devoted to exclusive grain growing for a number of years. This difficulty is mainly due to the physical condition of the soil. This Station has been quite successful in securing a good stand of clover during the past four years by sowing the seed on winter wheat about the first of March. This method has given very satisfactory results with heavy clay soils.

For the average farmer a rotation system of cropping is recommended. The method followed by the Station in the main consists of wheat succeeding a cultivated crop, such as rape, potatoes, or corn. Following the wheat clover is grown for two seasons, after which the soil is broken up for some cereal crop. The following example will serve to illustrate the advantages of this system. In the Fall of 1899 a field, which gave a yield of 20.50 bushels of wheat per acre that season, was fertilized with about fifteen common wagonloads of barnyard manure to the acre, and then was plowed about eight

inches deep. The following Spring the land was plowed again, worked down fine and planted to corn, potatoes, and other cultivated crops. Immediately after harvesting these crops the land was disked and winter wheat drilled in at the rate of one and one-fourth bushels per acre. About the first of March eight pounds per acre of red clover seed were sown. The yield of wheat was 40.50 bushels per acre. The following year, as elsewhere noted, the first crop of clover, consisting of 12.52 tons per acre, was cut for the silo and the second crop for hay, yielding 1.50 tons per acre of the cured product. Ordinarily the clover will be a profitable crop the second year, but in this instance the clover root-borer destroyed such a large proportion of the plants that it was deemed advisable to break the sod for a cereal crop. Thus it will be noted that four good crops were secured from two plowings. This system not only reduces the labor expense in the operation of the farm, but it also makes the land more productive, and at the same time perceptibly improves the texture of the soil.

Another good method for seeding down to clover is to plow the land to a good depth in the Fall. Then in the Spring as soon as the land is in condition, work down very fine and leave fallow until about the middle of May or the first of June. Then harrow it thoroughly so as to destroy all weeds and seed to clover with about two pounds of rape seed per acre, covering with a light harrow. If the soil is thoroughly pulverized and compact, the clover and rape will develop rapidly, and within about six weeks or two months will furnish an excellent pasture for sheep, hogs, or young cattle. Either of the two methods mentioned, when properly executed, will almost invariably result in securing a satisfactory stand of clover.

There are other methods of seeding down to clover which are more or less successfully employed. Such as seeding in the Fall or sowing with Spring grain. The success of these two methods rests very largely upon the peculiarity of the soil and season. Frequently when clover is sown in the Fall an early freeze destroys it, and that which is sown with spring grain is often injured by the lack of sufficient moisture during a dry summer. Sowing grain with clover in the Spring as a nurse crop is a popular error; for instead of being a nurse crop in the true sense of the term it is more appropriately called a "curse crop." The grain deprives the clover of the necessary moisture to carry the latter through the last portion of the first summer, which is the most critical period of its existence. How-

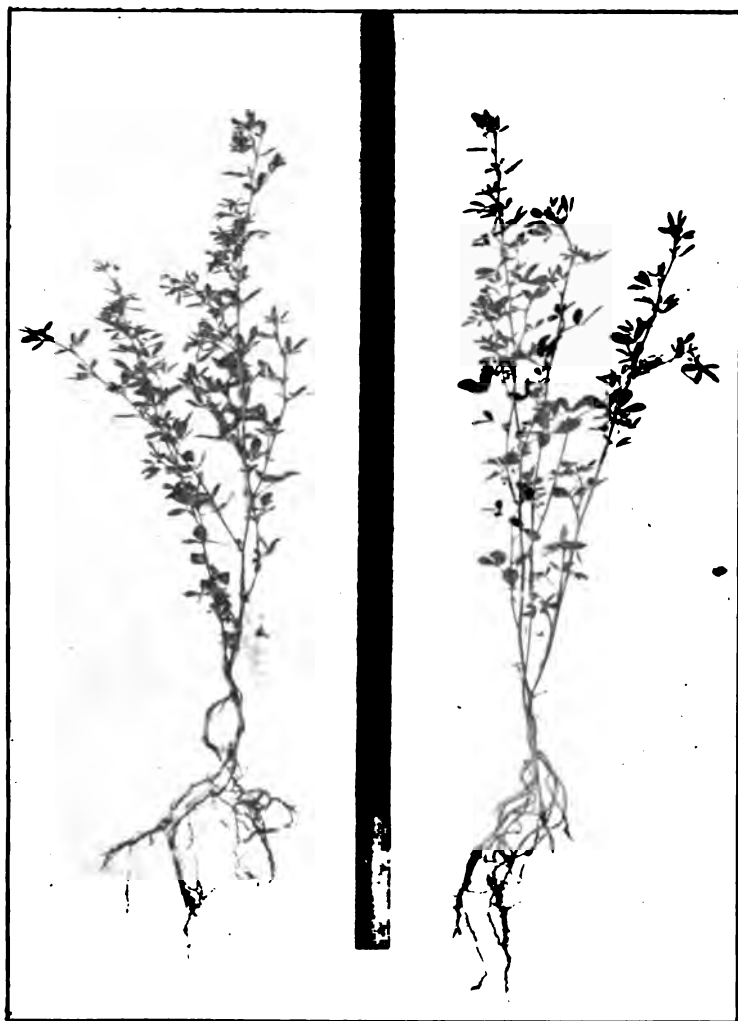


PLATE I.

ever, if clover has previously been grown on the land, the soil is well supplied with plant food and has a good texture, then seeding with spring grain will result favorably. For in this case the soil will possess a physical condition which is conducive to the conservation of moisture, thus furnishing sufficient for both the grain and young clover plants.

There is a wide variation in the opinion of farmers as to the proper quantity of clover seed to be sown, ranging all the way from five pounds to fifteen pounds per acre. We find that the proper amount of seed to be sown is governed by several conditions. The two principal factors perhaps are the germinating qualities of the seed and the degree of suitability of the soil for the plant. While five pounds of good seed per acre may be sufficient for some soils this amount will be totally inadequate for others. At this Station we have had excellent results with eight to ten pounds of seed per acre, usually putting on from six to eight pounds of red clover and two pounds of alsike. The alsike clover is a very desirable supplement of the red. The proportion of alsike sown should be governed by the character of the soil. On a heavy clay soil with poor drainage a larger proportion of alsike can be profitably used. A good proportion for this class of soil is four pounds each of red clover and alsike per acre.

Recognizing that clover is destined to be regarded as one of the most valuable forage crops grown in Western Oregon, we desire that this bulletin shall contain as much practical information relative to the production of this crop as may possibly be obtained. Hence the following letters, written at the solicitation of the Director, by two gentlemen who are generally recognized as being among our most successful farmers in the western portion of this State, are submitted with the full assurance that they will be appreciated.

"As to our method of getting a stand of clover will say that on our soil we have found only one way that we can depend on with certainty—about as follows: sow 10 or 12 pounds of common red clover, or better 6 to 8 lbs. of red clover with about 2 to 4 lbs. of alsike—sow alone or with 1 to 2 lbs. of rape seed to be pastured first season. Rape can easily be killed out if you want to cut crop for hay. The ground should be plowed early, and, after heavy rains are over it should be rolled and harrowed till you have a fine, solid seed-bed. No danger of getting too fine or too solid. On ground prepared in this way sow seed in the latter part of May or 1st of

June. Cover lightly and you are almost sure to get an even stand. Have not been successful with any other way. This is the sure way. Wet summers will doubtless bring a good stand when sown on fall wheat or with spring grain, but we seldom have wet summers. There are no crops like rape, clover and vetch—indeed they are the salvation of the Willamette Valley.

Monmouth, Oregon.

JNO. B. STUMP.

“Red clover can be grown successfully on any land that will grow wheat. Time for spring seeding, April 1st to May 15th. A very important thing is to work the soil when it is in proper condition. Plow the ground thoroughly and harrow well. If oats are to be sown drill in one and one half bushels, and one bushel per acre of wheat. Follow the drill with the harrow, and if this puts the ground in good condition, sow the clover seed and follow with another harrowing. After this use a roller if the condition of the land will permit. If the ground should not be in good condition after the drilling and harrowing put a roller after the harrow that follows the drill, then sow the clover and cover with the harrow. If the clover is sown in May the ground can be rolled immediately after the harrowing that covers the seed, but if sown earlier in the season defer the rolling until the grain and clover are up. Follow this by putting 50 lbs. of land plaster per acre carefully spreading the same evenly on the land. When the time arrives to cut the grain, cut as close to the ground as may be possible with a binder. Do no threshing in the field, so as to leave field clean for clover crop the following year. Neither allow any stock to run on the young clover the first year if the crop is intended for hay or seed. Would cut the crop the first year as soon as in full bloom, not allowing any blossoms to turn, for this is where many fail to get a good hay crop and lose on the seed crop by letting it stand too long for first cutting. The first crop should yield 2 to 3 tons of hay per acre. The crop for seed is usually cut in September when the blossoms are good and brown and the seed just past the dough. Cut the crop with a self rake machine and when well cured gather in close racks. It should be hulled when only in good condition i. e. when it is good and dry. The crop should yield 175 to 250 lbs. of seed per acre. The second year a hay and pasture crop can be secured after which the land should be plowed and seeded to oats or any other crop desired. The clover will leave the land mellow and good for other crops for several years.

When seeding clover on Fall grain, prefer to seed in February or up to the 15th of March on a snow or freeze, followed by 50 lbs. of land plaster per acre the last of April or 1st of May. Never had as good success in this way of seeding as in Spring. It is neither so clean nor even a crop and will usually take it one year longer to mature. Should a timothy meadow be desired, sow clover in the Spring as has been suggested, and in September after the grain has been harvested sow 3 or 4 pounds of timothy per acre on the stubble. The first year you cut pure clover hay and in September take off a seed crop. The second year the hay crop will be half timothy and clover which makes splendid feed—no seed crop this year. The third year you will have a clear crop of timothy hay, and should yield 2 to 3 tons per acre. Would suggest that about the 1st of May on the second year that 30 to 40 pounds of land plaster be put on per acre.

I will refer you to a piece of land containing 115 acres which was sown to clover and oats. Seeding was finished May 15th. The following September sowed 4 pounds of timothy seed per acre. Harvested 4,000 bushels of oats. These were sold at 35 cents per bushel, bringing \$1,400. The following year cut 275 tons of hay, some of this hay was sold for \$14.00 per ton on the farm, but say we estimate it at \$5.00 per ton, which would net \$1,375. The same year in September cut the second crop for seed which yielded 21,275 pounds of seed which brought 9 cents per pound or \$1,944.75. The second year there were cut from the field 250 tons of timothy and clover hay, for which we will allow \$5.00 per ton (which is a low figure), \$1,250. In September cut patches in the field for seed, getting 1,500 pounds at 10 cents per pound making \$150. Third year cut 300 tons of timothy hay. Sold this for \$9.00 per ton, or \$2,700. This would make the total gross receipts for the 115 acres for three years of \$8,789.75.

Now we will allow our neighbor who summerfallowed at that time 115 acres. Summerfallowed the first year and second year harvested his wheat. Allowing the wheat yield 30 bushels per acre and was sold for one dollar per bushel or \$3,450. A good many farmers would reseed this field in the Fall to wheat and we will allow them 25 bushels per acre or \$2,875 for this crop, thus making a total of \$6,325 in the three years as against \$8,789.75 for the 115 acres of clover, making a difference in favor of the clover of \$2,464.75, and a greater difference would be in the farming of the land, that had been in clover for the next 5 or 6 years.

During these three years no stock was allowed to run on the 115 acres sown to clover and timothy.

I would suggest that when clover is sown straight it should not be permitted to stand longer than two years, and if the land is sown to both clover and timothy not over three years at the longest. For by this time they have both passed their period of usefulness. Seed some other land to clover that needs a rest. Rotate in this way and follow the clover with other crops. Clover is king of all fertilizers for the Oregon soils.

Amity, Oregon.

W. H. McELDOWNEY.

The above letters certainly contain much valuable information for those contemplating seeding down their land to clover. We suggest, however, that the system of consuming the hay and grain with domestic live stock on the farm itself is much more profitable in the end than selling these products at their market value. To sell these products is simply burning the candle at both ends. While it is true that clover is a great fertilizer, nevertheless without this is consumed on the farm or an equivalent is returned to the soil the land will ultimately suffer for the lack of potash, phosphoric acid and lime. The better plan and the one that will be unquestionably the more satisfactory in the end is to feed the crude product of the farm to well bred live stock, thus not only insuring maximum returns from the farm but also conserving the fertility of the soil.

VETCH (*Vicia sativa*).

On the point of value as a forage crop for Western Oregon the vetch is a very close rival of clover. The vetch is indigenous to Western Oregon, hence all the domestic varieties do remarkably well in this section. In some respects the vetch is superior to clover. It is richer in protein, more palatable and possesses a wider range of adaptability than the latter. The principal objections to vetch are the annual seeding, difficulty of harvesting and its tendency to volunteer in the wheat crop, thus lessening the commercial value of the wheat. With reasonable care the two last objections may be obviated. The difficulty of harvesting may be overcome by sowing grain with the vetch to hold it up, or in case in early Spring the crop gives indications of a rank growth it may be pastured back as late as the first of May and then yield an excellent crop of hay or seed. The pasturing will shorten the length of the vine and cause it to stand up better, thus facilitating harvesting. Vetch can be

kept out of wheat, if care is exercised not to sow winter wheat on land that has produced a crop of vetch seed that season, or the preceding season.

While the vetch gathers nitrogen it does not develop a large root system, hence is inferior to clover as a soil renovator. However, the growing of vetch is highly beneficial to the soil, for it not only increases its nitrogen content and lightens the texture of a heavy clay soil, but also, owing to the density of its growth, it smothers a great many weeds.

Vetch is very hardy, hence the land requires but little preparation to secure a good stand. A common practice is to disk it in on stubble ground in the Fall, putting on about one bushel each of vetch and winter wheat, or winter oats per acre. If the crop is intended for seed, it is better to seed with winter oats as the vetch can be easily separated from the oats, thus insuring clean seed for the market.

Vetch makes an excellent winter cover crop for an orchard or garden. For this purpose the vetch should be sown alone, putting on at the rate of about one and one-fourth to one and one-half bushels per acre. Upon rather heavy clay soils that have been given thorough cultivation during the summer, a winter cover crop of vetch will render an invaluable service in maintaining a desirable texture of the soil as well as possibly retaining the nitrates that might otherwise leach away.

While vetch has to be sown each year this may be done, however, with the minimum amount of labor. Where the land is in fairly good physical condition and the seeding is done in the Fall a good harrowing is all that is necessary. Ordinarily, however, disking the ground before seeding is preferable. Vetch is also a good "catch" crop. For instance, in case the Spring seeding of clover should result in a light stand, vetch can be sown in the Fall and harrowed in without injury to the clover. The vetch and clover combined will yield a heavy crop of valuable hay, while the clover alone would perhaps have given an unprofitable yield.

There are two varieties of vetch generally grown in this section; the common vetch, *vicia sativa*, ordinarily called the Scotch tare, and the hairy vetch, *vicia villosa*. (The former is preferred owing to its character of growth and palatability). These are sometimes designated as Spring and Winter vetch, but this is an error, for they are both winter varieties, although either will pro-

duce a good crop of hay if sown moderately early in the Spring on good soil. They do better, however, if sown in the fall.

The hairy vetch, sand vetch, or Russian vetch, as it is sometimes called, is a vigorous grower and a very hardy variety. Its principal field of usefulness is perhaps for rather poor dry soil. There is also a possible field of usefulness for this variety on the unimproved lands of the Coast Range, especially in the heavy fern districts. From what we know of the habit of this plant we have confidence that if it is given a good start on these fern lands it will ultimately scatter all over the fern ridges of this section and furnish an immense amount of fairly good feed. The plan suggested for this work is to plant a few seeds ten feet apart each way and keep stock off for the first year. After this with judicious pasturing the plant will perpetuate itself and spread in every direction.

The seed of the *vicia villosa* is much smaller than that of the *vicia sativa*, hence a considerable less quantity per acre is sufficient for seeding. From a peck to a half bushel per acre is the usual quantity sown.

Spring Vetch.—While there are several varieties of the genuine spring vetch, they are really subvarieties of the *vicia sativa*. The one more commonly grown is almost identical with the common vetch except that it matures much more quickly. There is another spring variety that produces a white seed, although otherwise the plant is almost identical with the common *vicia sativa*.

The spring varieties of vetch are very useful under the soiling system for furnishing succulent and highly nutritious feed late in the season.

At the solicitation of the Director of this Station, the following letter was written by the pioneer vetch grower of this state:

"I herewith inclose you in brief detail my experience in raising and curing vetch. The crop has been one of the most successful with me on account of its sureness of growth, as well as being a palatable and nutritious stock food.

I have seeded vetch in the Fall and early Winter in every way imaginable. Have sometimes had it volunteer and bring a valuable crop. A successful way of seeding it, is to sow in the stubble early in the Fall, using a good sharp cultivator to cover; (the crop being easier cured than a heavier one with more cultivation.) I increase the amount of grain in the mixture according to the calculated weight of the vetch crop, which depends upon the capacity of the

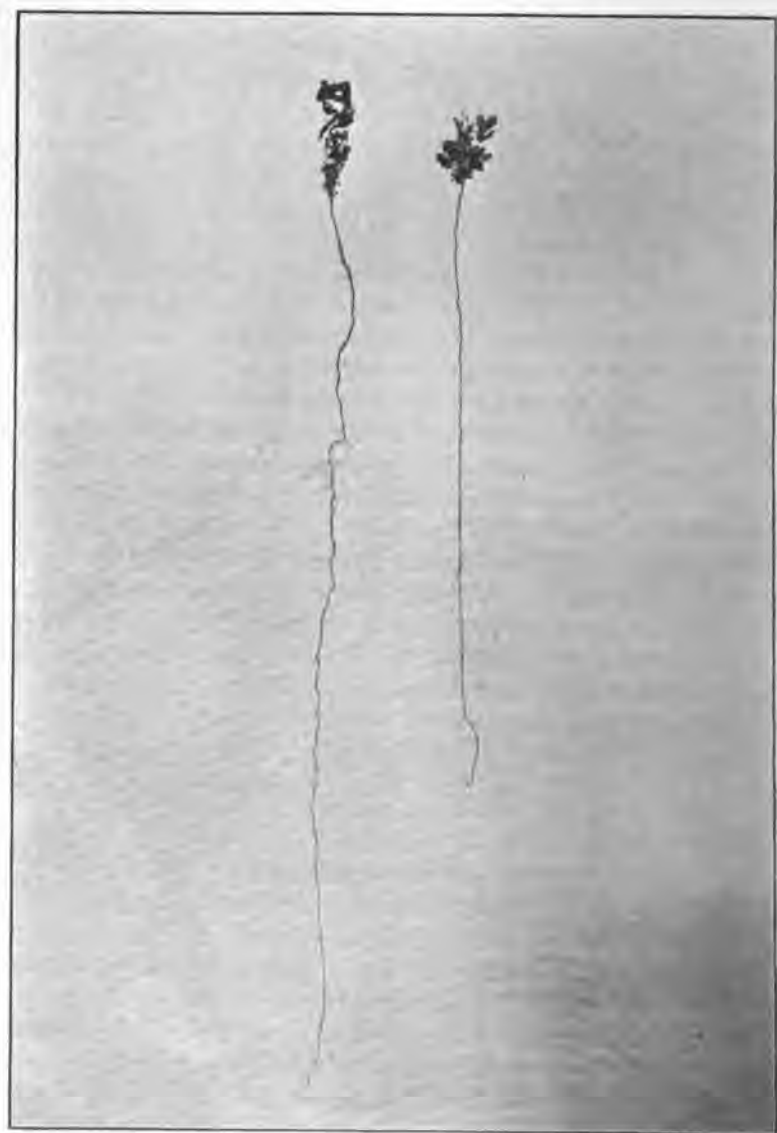


PLATE II.

soil to raise it. The successful curing of vetch hay in damp weather is attended with a great deal of difficulty, as the straw is juicy and of soft fibre; especially heavy crops, grown in rich soil, or that which has been forced with land plaster. Of the latter I have never used more than 50 pounds to the acre, in many cases a less amount is better. Lighter crops are proportionately easier cured.

Where the crop grows to a height of eight or ten feet and is flattened to the ground by previous rains, there is often difficulty in mowing. I have found very little trouble with a mower that cuts clean and is furnished with a divider that will ride smoothly over on the side of the sickle-bar; next to the gearing a wheel is preferable. I prefer to turn over heavy crops after cutting which can be done with very little labor using a light pole or pitch fork handle. One active man can turn the swaths behind the mower about as fast as it will cut them, provided they are cut clean. This prevents mold and further decay which takes place very soon where the lower stalk becomes damp and during warm, close weather, and the condition aggravated by the mower wheel pressing it close to the ground. Shocking can be done better without raking; this is where I have found the most difficulty as the vetch hay does not stand exposure without bleaching and loses its feeding value very rapidly. It needs a great deal of curing before putting into a large mow. I have found it well worth the labor to recock in a week or so, putting three or more into one. Better turn over the first one. The only sure way to cure a heavy crop of vetch is to put it in a silo, and when one has this choice the weather may govern the operation."

Centerville, Oregon.

A. CHALMERS.

When a seed crop of vetch is desired it is a good plan to sow on moderately rich land and dispense with the land plaster. If, however, the growth gives indication of luxuriance in the Spring it would be well to pasture the vetch heavily up to about the first of May. This method will materially shorten the straw and greatly facilitate the development of seed. No arbitrary rule can be strictly followed in handling the crop for seed. Ordinarily the seed crop should be cut when fully three-fourths of the pods are turning yellow and the seed is commencing to assume a dark color. If the crop is permitted to become too ripe before cutting, much seed will be lost, for the plant has a pronounced tendency to the undomesticated habit of scattering its seed for self perpetuation. If the crop

stands up well it may be cut with the binder and handled similarly to sheaf grain. This, however, can rarely be done successfully and the mower has to be brought into requisition. After the crop is cut it should be exposed to the sun for but a brief period. If the crop is light it can be raked and shocked, but in case it be heavy a better plan is to shock it without the use of the rake. Whenever practicable the crop should be hauled directly from the shock to the thrasher as the more often it is handled after it becomes dry the greater the waste of seed from shattering.

ALFALFA (*Medicago sativa*).

Alfalfa and aridity are usually closely associated for wherever irrigation is indispensable to successful agriculture alfalfa becomes the dominant crop. In these sections where water for irrigating purposes is available methods of production are well understood. Then again in the dryer sections of the state on subirrigated lands, or those supplied with a water table much below the reach of ordinary farm crops, alfalfa, owing to its ability to penetrate deeply into the underlying soil strata solves the problem of forage production. There is, however, a wider range of usefulness for this plant than is generally supposed. For instance in the great wheat belt of the Columbia River basin where the contour of the land precludes successful irrigation, alfalfa will yet prove to be a valuable crop. Before this condition is realized, methods of culture must be developed that are in harmony with the environment. In the great wheat growing areas of this section, alfalfa can scarcely be expected to give satisfactory results if sown broadcast. The plan adopted should, to the greatest possible extent, conserve soil moisture. This perhaps may be best secured by means of cultivation. Hence, the alfalfa should be sown in drills and cultivated similar to corn. This is not such a formidable task as would first appear. The work can be done very rapidly with a double cultivator, and the harrow can be frequently used to great advantage. The purpose of the cultivation is to reduce the evaporation of soil moisture to the minimum by destroying the continuity of the soil capillaries. The drills may be thirty to thirty-six inches apart. Just as soon as the plants are up, if sown in the Spring, a light cultivation should be given. This ought to be repeated every week or ten days during the first growing season. If weeds are troublesome in the rows, or the plants make a good growth the field may be mowed occasionally. The

ridging of the land through cultivation, or the development of large crowns by the plants may interfere with the convenience of harvesting. This can be obviated by cross-harrowing early in the Spring, late Fall, or immediately after the cutting of the first crop. In fact after the plants are well developed, cross cultivation at the proper season either with a cultivator or disk harrow will work no injury to the plants; but on the other hand will materially improve the surface of the ground and thus expedite the harvesting of the crop. It has been pretty conclusively demonstrated that old alfalfa fields are reinvigorated by the occasional liberal use of the disk harrow.

ALFALFA IN WESTERN OREGON.

As yet alfalfa growing in Western Oregon is purely in the experimental stage. This forage plant in the estimation of the farmers of this section occupies the same position as did clover twenty years ago. Then it was popularly believed that clover would not flourish on the wheat lands of the Valley.

There are undoubtedly large areas of land in this section that will produce profitable crops of alfalfa. Perhaps the two chief obstacles to success are, the close proximity of the water-table to the surface of the soil during a large portion of the winter, and the rather pronounced tendency of weeds and grasses to crowd out the alfalfa. The former difficulty may be overcome by tile drainage, and the latter can be kept largely in subjection by suitable cultural methods. Alfalfa possesses no especial advantages over red clover other than greater permanency of the crop. In fact, clover is the better crop for the purpose of a short rotation, or for rejuvenating the soil. Another possible serious hindrance is the danger of "bloat" in stock pastured on it in the early Spring, when, in addition to the extreme succulency of the plant, much moisture from rain and dew is present.

The heavy clay soils of this section are certainly not ideal for alfalfa; but it has been reasonably well demonstrated at this Station that such soils will support profitable crops of alfalfa. At the present, June the first, we are cutting a crop of second year alfalfa from a heavy clay undrained soil, that is yielding 9.66 tons of green forage per acre. The seed for this field came from an arid region and perhaps even better results would be secured with home grown seed. However, it is rather remarkable how quickly the root system of al-

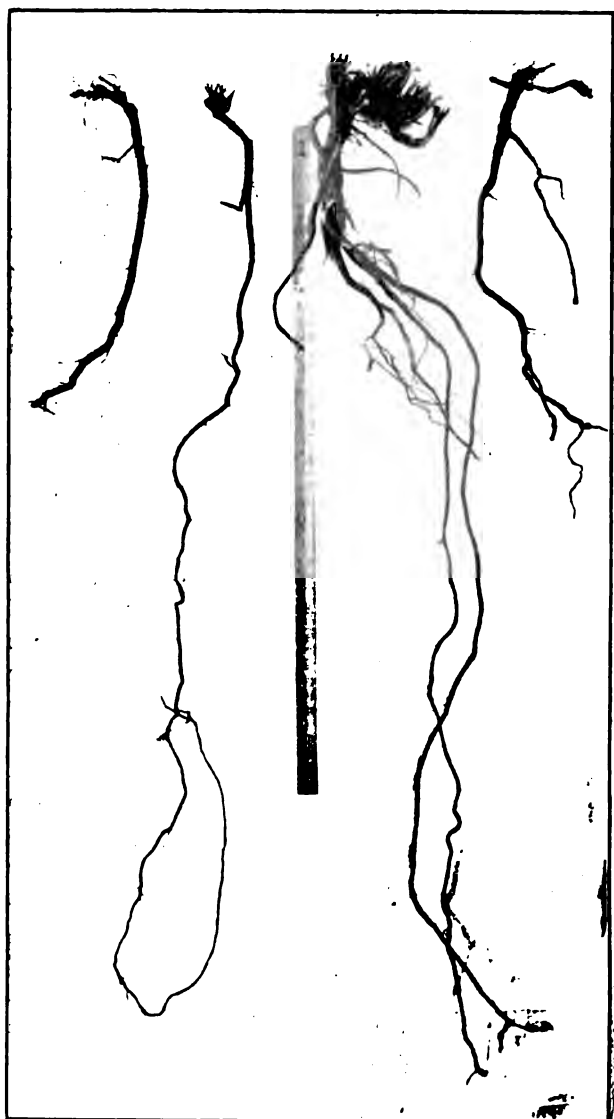


PLATE III.

falfa will change to meet conditions of soil and moisture. Plate I represents two typical six months old alfalfa plants grown at this Station in heavy clay soil.

Plate II represents two Turkestan alfalfa plants which were kindly furnished by Mr. F. M. Chrisman, Silver Lake, Oregon. The longer root of the two measured twenty-one and one half inches. This plant was taken up 99 days from the date of planting the seed and was grown without irrigation. The section from where these plants came is very arid and the soil is largely volcanic ash with a hard-pan of cemented sand and gravel about 18 inches below the surface. It is a good illustration of the capabilities of the plant to adapt itself to its environments. This marked difference in the root system of practically the same variety of plants grown under widely different conditions indicate the strong cosmopolitan character of alfalfa.

Plate III illustrates rather a peculiar development of alfalfa tap roots. These plants are taken from a plat 8 years old. A trench six feet deep was dug alongside the plat to permit an investigation of the development of the tap roots. The soil was heavy clay and tiled two and one-half feet deep. It was found that the tap roots of approximately 50 per cent of the plants either stopped or rotted off at the level of the tile, while about 50 per cent of the plants had tap roots extending to and even below the bottom of the trench. This is a good example of the survival of the fittest. It appears that the tap roots of about one-half of the plants could not withstand the effects of the water present at the above level, while the other half were uninjured. This also indicates that, by judicious selection, a type of alfalfa can ultimately be developed which will be better adapted to the soil and climatic conditions of this section than one suited to arid soils and grown under irrigation.

Method of Seeding.—This must be governed largely by local conditions. Land naturally well drained or which is tiled at least three feet deep, should be selected for this crop. If barnyard manure is available, put on from fifteen to twenty tons per acre in the Fall and plow under eight to ten inches deep. In the Spring, when the land is in condition to work, cut it up thoroughly with a disk harrow and work down very fine. Let it lie for a week or ten days, then give a good harrowing so as to destroy all weeds. Sow about fifteen pounds of clean seed per acre and cover with a harrow. If the soil is inclined to be dry finish with a roller. About the time the seed is sown, put on seventy-five to one hundred pounds of land plaster to the acre.

Soil Inoculation.—In case the land has not grown a crop of alfalfa before, it is advisable to inoculate it with soil taken from a field that has produced alfalfa with root nodules. Many failures with alfalfa are due to the want of the proper bacteria in the soil. Hence to guard against this possible chance of trouble, it is a good policy

to inoculate the soil before seeding down to alfalfa for the first time. The method employed is to secure soil from an old alfalfa field, and scatter evenly about one hundred pounds to the acre. It is better to make this application before seeding, and the impregnated soil should be thoroughly incorporated with the field soil by harrowing.

The care of the crop the first summer consists simply of running the mower over the ground occasionally to subdue weeds. If the weeds are not too numerous they may be permitted to lie on the ground as a mulch; but in case they are so heavy as to menace the crop by smothering it, they should be raked up and removed. Allow no stock to pasture on the alfalfa the first year. After the first season the crop will require little or no care. However, if after a few years grass and weeds become troublesome and the vigor of the alfalfa seems to be waning, a thorough disking of the land is beneficial. This should be done late in the Fall when the plants are in a dormant condition. Then the disk and harrow may be applied vigorously. In case the stand is growing thinner, reseeding may be practiced either in the Fall or early Spring. This may be accomplished by sowing the seed immediately preceding the last harrowing in the Fall, or by sowing and harrowing in early in the Spring.

From some cause the leaves of alfalfa at times will become yellow and the plant assumes an unthrifty appearance. When this condition manifests itself the crop should be cut at the earliest opportunity. The cutting seems to invigorate the plant when in this condition, and the succeeding crop rarely shows signs of unthriftiness.

CRIMSON CLOVER (*Trifolium incarnatum*).

This is an annual clover grown usually for two special purposes, either as a winter cover crop, or for soiling. The plant possesses considerable economic value as a forage crop for dairymen, and when its habits of growth are better understood, it will be more highly esteemed as an early soiling crop.

Crimson clover will flourish on a variety of soils but seems to prefer a sandy loam. It is a vigorous grower and, owing to its strong root development, is capable of securing nourishment from soils which will scarcely support red clover.

The principal cause of failure with this crop is perhaps late seeding in the Fall. The seed should be sown in August, if practicable, on land that has been cultivated during the summer. A very good plan is to sow on corn land immediately before the last cultivation, which of course should not be too deep. In some agricultural sections it is sown on grain stubble after a thorough disking, but this method is rarely successful without timely fall rains. When sown on ground that has produced a cultivated crop, there is usually sufficient moisture to germinate the seed promptly. This gives the plant an opportunity to attain a considerable growth before winter. The success of the crop depends largely upon proper development of

the plants in the Fall. Fifteen to twenty pounds of seed should be sown to the acre.

When crimson clover is sown early, it is usually ready to cut for soiling at this Station, from the first to the tenth of May. It not only furnishes an early supply of green feed, but is also exceedingly palatable. The plant under favorable conditions stools freely, and the stems while large are not woody. Stock will consume every vestige of the plant with relish.

Crimson clover is rich in protein; hence is valuable for draft horses as well as for dairy stock. It is better fed green than in the form of hay, although it makes good hay when cut at the proper stage of development. For the purpose of hay it should be cut just as soon as it is in full bloom. If cutting is deferred later the hay becomes dangerous, owing to the hardness of the hairs upon the seed hull. Animals fed on over-ripe hay made from this clover have been troubled with "hair balls" in the digestive track, sometimes producing death.

In addition to its value for soiling it also makes good ensilage. For this purpose it should be put into the silo when in full bloom.

While crimson clover makes a phenomenal growth at times, it is a little unreliable. In the Spring of 1902 the clover at this Station yielded 23.67 tons of green forage per acre, while this Spring it only yielded 6.67 tons. This variation, however, was almost wholly due to the difference in the time of germination of the seed. In the Fall of 1901 the seed germinated about the first of September, while in 1902, it did not germinate before about the first of November. Last Fall was unusually dry, hence the crop this season does not represent what the plant is capable of doing under more favorable conditions.

FIELD PEA (*Pisum arvense*).

The field pea does well in practically every agricultural section of the State. This wide range of growth renders it one of the most valuable field plants we have, both for its forage and grain. There are numerous varieties of the field pea, but the one most generally grown is the white Canadian. The crop can be utilized either for grain, hay, soiling, or the silo.

Pea hay is very nutritious and is relished both by cattle and sheep. It is not so palatable in the green state. In fact cows that have been accustomed to green clover and vetch do not take kindly to the pea. Hence at first it is difficult to get them to consume a sufficient amount to prevent a serious shrinkage in the milk flow. This trouble is not experienced with the hay and silage, for these are consumed with an apparent relish. The pea has a very high nutritive value. It is especially rich in albuminoids, containing approximately 17 per cent of digestible protein, thus making it one of the richest concentrated feeds produced on the farm.

Peas are usually sown with grain, although when grown with the

intention of permitting the hogs to harvest them, they may be sown alone. Ordinarily from 2 to 3 bushels of peas to one to two bushels of grain are sown to the acre; the amount being governed by the class and condition of the soil. On good land the maximum amount of seed may be sown. The pea yields well on such land, often producing from 20 to 30 bushels per acre. Like all other leguminous plants, the pea is a nitrogen gatherer, hence it is an excellent crop to rotate with the cereals.

Its principal pest is the weevil. The ravages of this insect may be averted somewhat by early sowing. The plant is hardy and will grow under low temperature, hence peas can be sown as early in the Spring as the condition of the ground will permit. Early sown peas do not suffer from the weevil to the extent that the later sown do. Unfortunately some of the seed drills have not sufficient capacity to handle peas, hence it is often necessary to sow them by hand. In this case the peas should be sown first and either covered with a disk, or cultivator, after which the grain can be drilled in. Some recommend plowing them under with a very shallow furrow, but this method has not been satisfactory at this Station. The better plan is to sow them with a grain drill whenever practicable.

FLAT PEA (*Lathyrus sylvestris*).

This variety of pea has been highly recommended for its drought-resisting qualities. It is a perennial, resembling the ornamental flowering pea very closely. The hay made from this pea is rich in protein. An analysis, made at the Michigan Station, showed 27 per cent crude protein.

The seed should be planted in a bed and the plants transplanted in their place when about two years old. It prefers an arid soil to that of a heavy clay in a humid climate. A plat at this Station has produced a fair quantity of forage each year for a number of years, but we do not regard the plant to be of much value for this section.

SANFOIN (*Espartette*, *Onobrychis sativa*).

This plant undoubtedly will prove an economic one for the rather dry hill lands in the southern portion of the state. It is a perennial legume, very durable, lasting under favorable conditions for quite a number of years. The plant flourishes in a rather dry, calcareous soil. It roots deeply and hence is capable of withstanding severe drought. Sanfoin will grow on land that is too poor to support either clover or alfalfa. It is more successful as a hay crop than for furnishing pasture. The plant does not possess the powers of recuperation of many other forage plants, such as the clovers, consequently it cannot stand close pasturing. It should be sown in the Spring at the rate of about 50 to 75 pounds of seed per acre. The seed must be covered with a good depth of soil to insure germination. This, however, should be governed by the character of the

soil and the amount of moisture it contains. On rather heavy moist soils a shallow covering of earth will suffice, while on a light, dry soil a deeper covering is required. On soils that are poor and dry, it is best to sow in drills about 20 inches apart and cultivate the first season. When sown in drills 20 to 30 pounds of seed per acre will be sufficient. With this system, land that is too poor and dry to support any other forage crop may be made to produce from one to two tons of sanfoin hay per acre, for many years.

SOY BEAN (*Glycine hispida*)

This plant is not readily adaptable to the climatic and soil conditions of Western Oregon. A few varieties have matured at this Station, but the yield of both seed and forage was not satisfactory. There may possibly be a field of usefulness for the soy bean as a supplementary crop with corn for ensilage. The soy beans mature about the season that corn does and being very rich in protein make an excellent combination with the latter. For this purpose the bean should be planted about the first of June in drills 2½ to 3 feet apart. The seed may be sown with the ordinary hand drill, but the ideal soy bean planter will drop single beans three or four inches apart. If the bean is grown for the purpose of mixing with corn in the silo, it should be planted about the middle of June on rich ground that has been thoroughly pulverized. The soy bean seems to be a subtropical plant, hence it is not advisable to plant it before the soil becomes warm.

There are perhaps localities in Eastern and Southern Oregon where this bean can be grown for the seed. The soy bean may be worthy of a trial in these sections. If they can be grown economically the crop may be profitably utilized as a supplementary feed for dairying. The bean is very rich in albuminoids, containing about 30 per cent of digestible protein.

It seems useless to attempt the growing of the soy bean in Western Oregon on a commercial scale, as the climatic conditions are decidedly unfavorable to its production.

COW PEA (*Vigna catjang*).

This pea is frequently confounded with the common northern field variety. It is strictly a southern forage plant, but by gradual acclimation its growth has extended into northern latitudes. Failure to mature seed has followed every attempt to grow the plant at this Station. Hence, we do not deem the cow pea of any practical value for Western Oregon.

Plate No. IV is presented to illustrate the early development of the plants for soiling. These samples were taken from the field May 15th, 1903. The crimson clover and sanfoin were in bloom on that date.

PLATE IV.

Red
CloverCrimson
CloverCommon
AlfalfaTurkestan
Alfalfa

Sanfoin

Vetch

In the preparation of the matter for this bulletin, the forage plants in the opinion of the author, were arranged in the order of their economic value in Western Oregon.

Red Clover.—Is clearly entitled to first place as an economical producer of forage, as well as being the most expeditious improver of the physical condition and fertility of the soil.

Alsike Clover.—Has not been treated separately. The same methods suggested for the seeding down to red clover will apply to this variety. Alsike does not produce a satisfactory growth after the first cutting. It is not predisposed to attacks of the root-borer, hence is more permanent than red clover. It will thrive on land too wet for the latter. The hay from this plant is nutritious and palatable. Without a seed crop is desired it should always be sown in connection with red clover.

Vicia Sativa.—Is the ideal vetch for Western Oregon. Fall sowing generally gives best results, although on a good soil, spring sowing is very satisfactory.

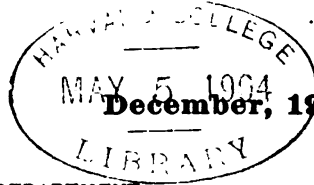
Alfalfa.—Should be sown on a fertile soil that is either naturally or artificially drained. Stock must not be permitted to forage on the plant the first season. Keep weeds subdued by frequent mowing. Sow in the Spring on a thoroughly pulverized soil. Subsoiling the land the previous season is helpful.

Crimson Clover.—While a valuable soiling crop, yields a hay of doubtful value—a danger obviated by cutting when in early bloom. Success with this plant rests largely in the matter of early Fall sowing.

Land Plaster.—Is beneficial to all leguminous plants on most of the soils of Western Oregon. Hence it is recommended to be used at the rate of 50 to 100 pounds per acre each Spring, not later than the first of April. If the land is rich and the crop luxuriant, the plaster should not be sown.

S A Green.

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Bulletin No. 77.

December, 1903.

HORTICULTURAL DEPARTMENT.

Oregon Agricultural Experiment Station.

CORVALLIS, OREGON.

A Continuation of Bulletin No. 74 on Onions, Also Notes on Strawberries and Varieties of Vegetables.

THE BULLETINS OF THIS STATION ARE SENT FREE TO ALL RESIDENTS
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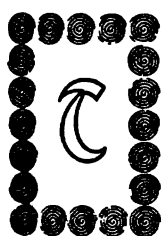
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A Continuation of Bulletin No. 74 on Onions, also Notes on Strawberries and Varieties of Vegetables.

By GEORGE COOTE.



THE subject matter of this bulletin is to a great extent a repetition of Bulletin No. 74 of this Station, and is designed to give the more complete results of experiments in growing the onion from plants raised in hot beds and set out in the open ground in early spring, and at the same time sowing the seed of the same varieties in the open ground under like conditions and giving to each the same general cultivation. The growing of the onion from plants raised in hotbeds has been practiced by the Portugese for a great number of years. But with us in Oregon it is practically quite new; therefore, for the purpose of demonstrating the advantages of this method on our dry soils, this experiment was begun in 1900, and has been carried on each year in succession without the aid of irrigation. The soil is what is termed a basaltic loam, which is well adapted to the growth of the onion.

In continuing this experiment, the past year, the plants, were set out on land that had not been previously fertilized in the Fall, and had not been manured since 1897, but had been constantly producing other crops of vegetables, such as peas, beans, lettuce, squash, parsnip and cabbage. The object in not manuring was to demonstrate what success could be obtained in as natural a way as possible without the plants being forced into growth by the aid of a fertilizer. Better results no doubt would have been had in the size of the onion and yield per acre had manure been applied in the Fall.

TREATMENT OF THE SOIL PREVIOUS TO PLANTING.

In the early Fall the ground was plowed very deep and laid up as roughly as was possible. This was done for the purpose of giving every chance for the surface of the soil to dry out at the earliest



Plate No. 1.

possible time in early Spring, for when the surface of the ground lies smoothly it will not dry out as rapidly as when laid up in a rough state.

In the climate of the Willamette Valley, one should be constantly on the watch for the opportunity to plant early, for the delay of only two or three days might be the cause of having to wait six or seven weeks perhaps for suitable weather to plant, and this means a great difference to the growth of the crop.

The same treatment has been given in the matter of raising the young plants, as stated in Bulletin No. 74, with the exception that that they were not given such a high temperature, but merely setting the boxes containing the seed in cold frames, protected from frost, when necessary, by covering the glass with hay, on the top of which boards were placed, so as to prevent the hay from being displaced by wind, and to protect it from moisture. When frosts occurred the covering material was not removed until ten o'clock the following morning. At no time during the season was the frost severe enough to prevent light and air being given to the plants every day while growing in the frames.

The plants did not receive the usual pricking out from the seed boxes, which is the general custom when sown in this manner, but remain as sown. This was done to see if the plants would make a good average growth without the expense of so doing, thus saving a good deal of time and labor.

The sowing of the first batch of seed of each variety for setting out was made in boxes on the 22d of January, and the plants grew, as mentioned, until they were large enough to set out in the open ground, which was on March 25th.

For testing the difference in the two methods of cultivation, seed was sown in open ground February 28th; as the young plants advanced, they received in both methods the same attention in every respect. Notes were carefully taken during the growing season, also the yield per acre, the date of harvesting, and the keeping qualities. The accompanying cuts give the difference in the growth of each variety, being as near the average size as could be obtained.



Plate No. 2.

NAME AND DESCRIPTION OF VARIETIES,

SUTTON'S AILSA CRAIG (Plate No. 1).

A variety introduced by Sutton & Co., England, a very large growing onion, resembling the giant Rocca in many respects, quite mild in flavor, and is of excellent keeping qualities. Matures well, and is an all-round variety both for market and general use:

Sown in boxes; date of sowing, Jan. 22d; date of planting, Mar. 25th; date of harvesting, August 24th; Yield per acre, 992 bushels.

AUSTRALIAN BROWN (Plate No. 2).

Grown from seed raised by the Oregon Experiment Station, a variety that is becoming well known, being of medium size and even in shape, flavor somewhat strong; maturing early; a long-keeping variety, and very firm in texture. Can be highly recommended:

Sown in boxes; date of sowing, Jan. 22d; date of planting, Mar. 21st; date of harvesting, Aug. 24th; yield per acre, 648 bushels.

WEATHERFIELD (Plate No. 3).

Color dark red, medium to large. Not as good a keeper as the above, and does not mature so well; inclined to be strong, and very easily excited to growth during damp, warm weather throughout the winter season:

Sown in boxes; date of sowing, Jan. 22d; date of planting, Mar. 21st; date of harvesting, Aug. 24th; yield per acre, 515 bushels.

SILVER SKIN (Plate No. 4).

Medium to large; flesh white and mild, resembling Silver King, but not so large; matured well under this method, and is a good keeping variety:

Sown in boxes; date of sowing, Jan. 22d; date of planting, Mar. 25th; date of harvesting, Aug. 24th; yield per acre, 432 bushels.

YELLOW GLOBE (Plate No. 5).

Large, firm, roundish in form, slightly tapering at the neck, in color resembling the Yellow Danver; a good mild flavor, also good keeping qualities:

Sown in boxes; date of sowing, Jan. 22d; date of planting, Mar. 21st; date of harvesting, Aug. 24th; yield per acre, 770 bushels.

The varieties of onions noted below are duplicates of the above, sown in open ground and cultivated as already indicated:



Plate No. 3.

	How sown.	Planted.	Harvested.	Yield per acre.
Sutton's Ailsa Craig...	Open field	Feb. 28	Aug. 28	393 bush.
Australian Brown.....	Open field	Feb. 28	Aug. 28	525 bush.
Red Weatherfield.....	Open field	Feb. 28	Aug. 28	263 bush.
Silver Skin.....	Open field	Feb. 28	Aug. 28	280 bush.
Yellow Globe.....	Open field	Feb. 28	Aug. 28	485 bush.

(The following three varieties received too late, consequently are not in competition with the above):

SOUTHAMPTON LARGE YELLOW GLOBE.

Resembles the Yellow Globe in every respect, but did not mature well; is not a good keeping variety.

Sown in open ground; date of planting, Feb. 28; date of harvesting, Aug. 28th; yield per acre, 87 bushels.

WHITE SPANISH.

Seed received from U. S. Department of Agriculture. Bulb greenish white, quite mild; not an extra good keeper.

Sown in open ground; date of planting, Feb. 28th; date of harvesting, Aug. 28th; yield per acre, 485 bushels.

BURPEE'S NAMELESS.

Bulb made only small growth, being a good second in productiveness; has the qualities of being a good keeping variety. Needs further testing to speak fully of its merits.

Sown in open ground; date of planting, Feb. 28th; date of harvesting, Aug. 28th; yield per acre, 160 bushels.

The following four varieties of peas were tested on the experiment grounds during the summer of 1903, and proved a valuable addition to the already long list of varieties:

CARTER'S MODEL TELEPHONE.

Averaging two feet in height; plant making a very strong growth and branching out a great deal; leaves quite broad, in color dark green; producing thick heavy pods, measuring from three and one-half to four inches in length, well filled, six to eight large peas in pod, of good quality.

Sowed, Feb. 28th; germinated, Mar. 27th; blossomed, May 24th; edible maturity, June 22d; marketable maturity, June 28th.

CARTER'S IMPROVED ANTICIPATION.

This may be classed among the dwarf varieties, as it makes a



Plate No. 4.

growth above eighteen inches; is very prolific, producing pods from three to three and one-half inches in length, averaging six large peas in pod, coming in with the late varieties.

Sowed, Feb. 28th; germinated, Mar. 27th; blossomed, May 30th; edible maturity, July 1st; marketable maturity, July 10th.

CARTER'S DANDY STRATAGEM.

May also be classed as dwarf, averaging in height fourteen to sixteen inches; dark green color; very close jointed, or compact growth, producing pod three and one-half to four inches long, containing five to six peas. Fair quality.

Sowed, Feb. 28th; germinated, April 1st; edible maturity, July 10th; marketable maturity, July 20th.

CARTER'S DWARF TELEPHONE.

Resembles Model Telephone, but is somewhat dwarfed, and of a more robust growth; leaves large and heavy in substance; vine stout, producing abundance of pods three and one-half to four inches in length, averaging seven large peas in pod. A variety that can be highly recommended for general cultivation.

Sowed, Feb. 28th; germinated, Mar. 27; bloomed, May 28th; edible maturity, June 20th; marketable maturity, June 27th.

BURPEE'S KELVEDONIAN.

Plant makes a growth of three to four feet, dark green, quite productive. Pods three and a half to four inches in length, containing an average of eight peas in pod of good quality.

Date of sowing, May 5; date of germinating, May 22; date of blooming, June 24; edible maturity, July 16; marketable maturity July 23.

Herewith are presented a few practical remarks on the cultivation of the strawberry. The strawberry will grow in almost any good soil, providing it is not tenacious. Neither will ground that dries out readily be suitable, as the plant requires a great amount of water, in order to bring the fruit to a healthy maturity. Once the plant suffers for want of moisture at the roots, the whole crop will be very much retarded and a great quantity will not come to maturity. A soil that is naturally, somewhat, but not too moist, will answer well.



Plate No. 5.

PREPARATION OF SOIL BEFORE PLANTING.

Before planting, the ground should be well manured with well composted stable manure, the latter plowed under as deeply as possible. The object for so doing is, that the roots will penetrate downwards after plant food and thus be in a position to gather moisture from the soil for a much longer period than would be the case if manure were near the surface. In experiments with the deep and shallow plowing in the manure, the former has proved of much more benefit than the latter.

SEASON FOR PLANTING.

The best time for planting new plantings is soon after the first rains in the fall and the young plants have made a good root growth. Great advantage will be derived from early fall planting over spring set plants, inasmuch as the fall plants will become well established in the soil during late fall and winter, and therefore will make stronger and better plants and will be found to be in better condition to withstand the drought of summer.

REMOVING RUNNERS.

The runners should all be removed during the first season, as the young plants will be greatly reduced in vigor if these are permitted to grow. The second year, if the variety is to be perpetuated, three or four runners may be induced to grow and the remainder kept trimmed off. A stone or clod of earth may be placed on the runner near the young plant, in order that it may be encouraged to make root more freely by being kept in close proximity to the soil, and all runners produced by the plant should be removed. By so doing, strong, healthy plants will be produced and will weaken the parent plant but little, producing a much stronger plant for re-setting.

The following varieties of strawberries were received from Mr. Mark Thompson, Rio Vista, Virginia, for trial. The plants were set the first week in February and made a medium growth.

BENNET'S SEEDLING (PERFECT).

Berry conical and inclined to be soft for market purposes; a good rich red color; flavor only moderate; on maturity the seeds become dark; plant makes a compact growth; berry medium size.

AUTO (PERFECT).

A very compact growing plant; berry heart shaped, becoming much flattened at the point or apex; rather soft in texture; good flavor; medium size; foliage very dark green.

EXCELSIOR (PERFECT).

Berry round in shape; medium size, quite firm; very deep red; somewhat sour but not too much; has the qualities of making a valuable marketable variety on account of its firmness; plant makes a straggling growth; foliage dark green.

ENORMOUS (IMPERFECT).

Produced large fruit; irregular heart shaped; a good dark red; in texture soft, and only medium in flavor; foliage deep green; has all the qualities of making an excellent berry for home use.

DARLING (PERFECT).

Berry conical, having a rough appearance on the surface; in size medium to large; soft in texture; color dark red; good quality; a valuable variety for home use; plant makes a moderate growth; foliage dark green.

BISMARCK (PERFECT).

The plants made a good, strong growth; berry large, soft; flavor good; color light red; not a heavy producer by any means in this locality.

DROUGH KING (IMPERFECT).

Berry conical, small, good quality; color deep red; somewhat sour; a prolific producer, both as to runners and fruit.

EMPEROR (PERFECT).

Color of fruit, deep red; seed quite red at maturity; berry has a rough appearance and medium in size; plants did not make a satisfactory growth.

MRS. MARK ANNA (PERFECT).

Berry a little irregular in shape pertaining to round, of a beautiful red color and very attractive to the eye; dark green foliage and bright color; is very firm and good quality; has the makeup of a good shipping berry on account of both firmness and color; seeds when fully matured are bright yellow; is worthy of extended trial.

LESTER LOVETT (PERFECT).

Berry large, conical, pertaining to heart shape; rich in quality; large, color red, and quite handsome; has the makeup of being a good shipping variety.

MAMMOTH QUEEN, THOMPSON (PERFECT).

This is an early berry and handsome; moderately firm in texture; quality good; a very promising variety; plants very vigorous in growth.

LADY THOMPSON (PERFECT).

Plants made a vigorous growth and productive; berry quite uniform, roundish in shape, of fairly good size and firm; a little tart but not disagreeably so; makes a spreading growth and produces a great number of runners.

THOMPSON'S EARLIEST (PERFECT).

Berries small, medium, firm; color light red resembling the Alpines to a great extent, but makes a compact growth; not of much value in this locality.

SUNSHINE (IMPERFECT).

Quite a large berry; light red color; firm, quality fair; a vigorous grower; leaves borne on a long leaf stalk; from all indications is not quite well adapted to this locality.

THOMPSON'S NO. 501 (PERFECT).

An early blooming variety; on this account the early bloom were badly cut by late frost; berries small and even, light red, soft; a strong grower producing many runners; fruit matured May 16; not productive here.

THOMPSON'S NO. 502 (PERFECT).

First bloom opened March 29; cut by frost which occurred April 10; not suited to this climate; what few berries matured were quite firm and excellent quality.

THOMPSON'S NO. 503 (PERFECT)

A large, red, oval berry; firm, of excellent quality maturing June 6; plant compact growing; a very promising all round berry.

In the Spring of 1903, the Station received from W. Atlee Burpee

and Co., Philadelphia, two varieties of corn, two of cabbage and one of cucumber, all of which have been grown during the summer on the Station experiment grounds, with the results as follows:

CUCUMBER—FORDHOOK FAMOUS.

Planted, May 27; germinated, June 8; came to marketable maturity, July 20, and proved to be a very prolific variety, giving great satisfaction, producing cucumbers from two to twelve inches in length and from two to three inches in diameter. The vines are short jointed, spread but little and one of the best ever tested on these grounds.

CORN—GOLDEN BANTAM.

Planted, May 5; germinated, May 22; tasseled, July 28; edible maturity, Aug. 20; height of plant when full grown, three feet. The grains of corn were very unevenly set on the cob, some ears as much as half were missing; that which did develop did not mature well. I do not think this to be any fault of the variety and attributed the results to climatic conditions to a great extent.

CORN—WHITE EVERGREEN.

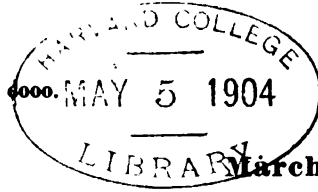
Planted, May 5; germinated, May 22; marketable maturity, Sept. 2; average height of plant, four feet; produced large, well filled ears, maturing fairly well considering locality.

CABBAGE—NEW EARLY BASEBALL.

Sown in flats Feb. 13, in cold frames; planted out in open ground, May 5; edible maturity, July 12; marketable maturity, July 19; produced small, solid heads from one to one and a half pounds. Small as the variety is, it is a very valuable, quick growing variety for home use, if not for market purposes.

CABBAGE—NEW EARLY STONEHEAD.

Sown in flats, Feb. 13; planted in open ground, May 5; marketable maturity, July 16; a splendid early variety, being a few days in advance of Early Baseball, and larger; very solid heads from one and a half to three pounds in weight; an excellent early cabbage both for market and home use.



Bulletin No. 78.

March, 1904.

S A Green.

DEPARTMENT OF BACTERIOLOGY.

Oregon Agricultural Experiment Station.

CORVALLIS, OREGON.

Canning Cheese.

By E. F. PERNOT.

**THE BULLETINS OF THIS STATION ARE SENT FREE TO ALL RESIDENTS
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CANNING CHEESE.

BY E. F. PERNOT.

The making of first-class cheese of a standard flavor is attended with many difficulties and uncertainties, although made with material from the same source, and under the same conditions. All of these difficulties have not yet been overcome, and are repeated from time to time, causing more or less serious loss.

As cheese is found on the market at present, there is a striking difference in flavor, consistency, and structure; varying from a tough, waxy, sour curd which is both unpalatable and indigestible, to a crumbling, pungent material bordering upon rankness.

It is almost impossible to purchase two samples of cheese of the same character, and there is far more inferior cheese on the market than that which is first-class. Many people cannot eat the ordinary cheese because of its indigestible qualities. These conditions have had a tendency to diminish the consumption of this nutritious article of food.

Butter makers had struggled through many trials and difficulties to produce butter of a standard flavor, until the introduction of the cream separator which has revolutionized that branch of dairying into one of our leading industries. Following the cream separator came the use of "starters" consisting of pure cultures of selected organisms, which places the power in the hands of dairymen to control the flavor of butter to such a degree of certainty, that now we have creameries producing butter of a standard flavor and quality throughout the year, stimulating an increased valuation and consumption of the article.

These results have been attained in making butter, by the control and proper use of organisms; and there is a possibility of attaining like results in making cheese, notwithstanding there are many more difficulties to overcome, owing to its being a more elaborate process requiring greater time, and consequently, additional opportunities for objectionable reactions to take place.

Milk is an ideal culture medium for a great many varieties of organisms, which, under favorable conditions, develop very rapidly. Feeding upon the material, they excrete products characteristic of their kind, and each of these chemical products reacts upon the different constituents of milk; some by a peptonizing action coagulate the casein, while others by their enzyme action may re-dissolve it again, forming still more complex chemical compounds. Those producing lactic acid have a tendency to increase at the expense of others.

A bacterial analysis of cheese reveals the presence of different organisms, each producing ptomaines in proportion to its activities, the predominating one exerting the greatest influence over the odor and flavor of the material in which it grows.

Hence, if fresh milk from which we desire to make cheese be inoculated with a pure culture of a selected organism, we may expect

it to be largely instrumental in producing a flavor and odor in the cheese peculiar to its action upon milk and curd.

One great difficulty which has been experienced in successfully controlling flavor in cheese is the prevention of other organisms, including mould, from entering during the process of curing. The first attempt to obviate this, was to coat the cheese with paraffin, which was a step in advance, yet not quite satisfactory owing to the scaling and cracking nature of paraffin, especially when handling the cheese. The next step was to can the curd in hermetically sealed tin cans, which is the subject of this bulletin, in which the success and failures met with will be recorded.

Making the Curd.

The fresh milk as it was received at the dairy was weighed and placed in vats, and immediately inoculated with a pure culture of organisms which had previously been grown in sterile milk for twenty-four hours. When the proper acid reaction had taken place, rennet was added; after the curd was formed it was cut and heated in the usual manner until a proper acid reaction was reached, which was determined by the hot iron test. The whey was drawn off and the curd "matted" or "cheddared" at a temperature and for a time sufficient to develop the required acidity, again determined by the hot iron test. The matted curd was then cut with a "Harris" curd mill, then salted and packed into cans or hoops.

Preparing the Cans.

Round cans made to contain one, two and one-half and five pounds each, were procured from a local tin-ner. They were well scrubbed with hot water and soda, thoroughly rinsed and dried; then, in order to protect the tin from the action of the salt and acid, the first cans used were lined with parchment butter paper, but as this was an annoyance in filling the cans and proved to be an imperfect protection to the tin, paraffining the can was adopted; this method consisted of placing some paraffin of a high melting point in the can, heating it very hot, then revolving the can and emptying out all that would not adhere into another can, and so on until all were coated; the covers were treated in a similar manner. When cooled, a thin film of paraffine was found covering the entire surface of tin which came in contact with the curd. Upon opening these cans six months after filling, they were as bright as new.

Filling the Cans.

When the curd was ready for pressing, it was placed in the cans in small quantities at a time and firmly pressed with an instrument similar to a wooden potato masher. As it was found impossible to fill the cans full enough to admit of further pressing, without leaving an air space between curd and cover, a loose tin band about two inches wide was inserted and filled in the same manner as the can, then a circular block of wood was placed on top and inside of the band, the cans were placed one behind another in the cheese press where they remained under fair pressure over night. In the morn-

ing the circular blocks and bands were removed, covers fitted on and soldered, hermetically sealing the can. It was found necessary to remove a small portion of the curd from immediately beneath where the cover was to be soldered, as the fat and moisture oozed out and interfered with soldering.

The Proper Time For Filling Cans. The proper condition of the curd at the time of filling the cans was a matter of experiment. In order to determine this, cans were filled at regular intervals of one hour from the time the whey was drawn off until one hour after milling and salting, and it was found later that in all cases, curd, milled and canned one-half hour after salting, gave the best results.

As there is no evaporation while curing, the curd must not be too wet or there will be unabsorbed whey when the can is opened. Less than the usual amount of salt must be added because it is all retained. In curing by the ordinary method there is a constant evaporation going on which brings the salt to the surface in solution where it crystallizes, diminishing the saltiness of the cheese. The latest experiment was to press the curd in hoops in the regular manner after which the bandage was removed and the green cheese slipped into cans which were made to fit, and covers immediately soldered on. Five-pound and twenty-three pound cheeses were made in this manner.

Curing the Cheese. A good feature of canned cheese is the curing, which obviates the constant care incident to the ordinary method, for after the cans are placed in the curing room they require no further attention other than to keep the temperature low and constant; humidity, dryness, vermin or mould cannot affect it.

In order to ascertain the progress in curing, lots of from six to fifteen cans were filled at a time so that they might be opened at regular intervals, varying from six weeks to one year.

The first can was opened six weeks after being filled, and the cheese, for its age, was well ripened, of an excellent flavor and odor, the texture was friable, delicate and quite superior to that of any other cheese. Several cans were opened at each of the various times, and a gradual increase of the delicate flavor was noticeable, but even in a can one year old it did not become strong and rank. There seemed to be a limit reached in the ripening, after which it remained unchanged. Very naturally there was no rind, no mould, and no loss in weight through evaporation, a pound of curd produced a pound of cheese.

Effect of Temperature During Curing. The first lots of cheese canned were placed to cure in a small room adjoining the laboratory which was situated up stairs in a wooden building. The temperature of this room was kept at about 60°F until the summer months when it reached about 75°F. All the cheese cured under these conditions was good, but unfortunately one day

in early July the temperature suddenly rose to over 100°F, the consequence was that all the cheeses that were in different stages of curing, were ruined. Those which were three months old, or older, were not affected. The younger the curd, the more it was injured. Some cans sprung a leak, others swelled and even bursted, and most of the unripened curd turned bitter; in several cans of fresh curd the butter fat was found to have separated from the curd.

Another lot was selected to cure at a temperature of 62°F. One month after, the temperature rose to 80°F and the cheese turned bitter. In every case where there was a high temperature in curing, or a sudden change of temperature from low to high, the cheese was spoiled. After three months curing, change of temperature seemed to have no bad effect, but by far the most satisfactory results were obtained from cheese which was cured at a constant temperature of 60°F.

Testing Its Shipping Qualities. In order to test its shipping qualities, two one-pound cans of cheese which had been cured for three months, were sent by mail to U. S. Consul H. B. Miller at New Chwang, China, with directions to open one can for sampling, the other to be returned unopened, thus giving it twice the traveling distance. Mr. Miller found the cheese to be of a good quality and submitted it to a Russian cheese expert, who pronounced it of excellent flavor and structure. The cheese which was returned, was uninjured by the shipping.

Two one-pound cans were also sent to Rev. J. H. Kilpack, Sutton, Surrey, England; they were returned from the New York post office, on account of there being no parcel package mail system between America and England. They were again forwarded to the Department of Agriculture by mail and from thence to their destination by express. Mr. Kilpack submitted one can to an English cheese importer who pronounced it of the best quality of States cheese. The other can was returned, and the cheese found to be in excellent condition. Other cans were sent to various points in America with the same results.

Doctor True and Major Alvord, of the Department of Agriculture, pronounced it fine cheese, smooth and mild, with a pleasant flavor and especially suited for export trade.

It would seem as if these tests fairly demonstrated that shipping had no detrimental effect upon canned cheese, but it is to be remembered, however, that the cheese must be reasonably well cured before submitting it to the extreme changes of temperature incident to shipping long distances.

Study of the Organisms and Their Action. The most difficult feature of an experiment of this nature, is to determine the reaction of organisms in a material composed of animal matter, and the relation which they bear to the finished product, when one or more varieties are acting simultaneously forming chemicals of both a simple and a compound character.

When we attempt to understand fully the reaction of even a pure culture of one organism in milk and its products, it becomes a difficult problem; much more so is it, when several varieties are acting on the same material and the products of each other.

The continued action of organisms in material is in itself a minor factor in the ultimate results, ptomaines which they produce continue their reaction long after the organisms have ceased their activities, consequently: if we inoculate fresh milk for cheese making with a pure culture of some selected germ, its ptomain will predominate, governing the odor and flavor of the finished product by its action upon some constituent of the curd while curing.

This was quite plainly demonstrated in the many instances in this experiment where pure cultures were used to inoculate fresh milk which was subsequently made into cheese. The peculiar flavor was so pronounced as to be undoubtedly due to the organism. Some produced a mild, delicate flavor, while others were sharp and acidulent.

Most of the pure cultures were obtained by making plate cultures from milk, and from samples of good cheese of both domestic and foreign makes. In selecting the germs, those were chosen which formed a firm curd without re-dissolving the casein when grown in sterile milk; then, before adopting them, they were tested for the flavor which they would produce.

A large number of cultures were necessarily handled to select even seven varieties; two of these gave the same flavor in the cheese, leaving six, one of these six gave a fishy odor to the curd in the vat so that it had to be rejected. Another formed too much gas, swelling the cans while curing, so that only four remained giving good results, although the first selection of seven reacted suitably in a milk culture.

Just before sealing the cans, a sample of the curd was taken from beneath the surface, and plate cultures made from it, to determine the organisms present at the time of canning.

It was found that cultures from curd which had been inoculated, contained a large number of the organisms used, and but few others.

When the cans were opened, cultures were again made as before, to determine whether the organisms had increased or diminished during the time of curing, and it was found that they had materially decreased in number per centigram of cheese, and some varieties which had found their way into the milk had disappeared.

The time will come when cheese will be made of a standard quality by the use of pure cultures as "starters," using organisms which possess economic value.

This experiment has covered a period of nearly two years, during which time a great many pounds of cheese were made under various conditions; it has demonstrated the possibility and practicability of controlling the flavor by the use of pure cultures. At every cheese making, where a culture was used, a check cheese

**Using Pure
Cultures.**

was cured in the ordinary manner, the flavors always corresponded with those which had been cured in cans, but to a much less marked degree.

The market now demands food to be in sealed packages and not so much in bulk as formerly; and the sale of cheese will be increased when it can be purchased in cans or packages upon which is marked its age and flavor, the latter being designated by letter or by name; this will be accomplished by the use of pure cultures and by curing the cheese in cans, or by some other means which will exclude the influence of other organisms.

It seems as though the present method of making cheese is not in keeping with the care exercised in making butter.

From the time milk is received at the dairy until the butter is wrapped in paper, the hands of a modern dairyman never come in contact with either material or product. In cheese making it is handled with the hands throughout the process, and it is not uncommon to see an operator bending over a vat with his hands and arms submerged nearly to the elbows, stirring the curd during the "cooking" and other parts of the operation. This would interfere to a more marked degree in the flavor of *cheese* made with a pure culture, than it would with *butter* if treated in the same manner, because the flavoring of cheese is a secondary reaction.

Means may yet be devised, by which the curd will be handled with fingered paddles, or other implements, doing the work of the hands, thus obviating the introduction of many objectionable germs.

As an article of food for export trade, or army use,
Conclusion. cheese cured in cans would be very desirable, as it is condensed, nutritious, and in convenient form for transportation. There are others besides cheddar cheese, which could be made and cured in cans. A soft cheese having the consistency of thick cream, that could be spread upon bread, would likely find a ready market in the Orient. Some work was done in this line, but no definite results reached.

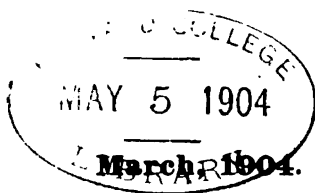
Several lots of cheese were canned without previously inoculating the milk, and they turned out very well. Inoculating the milk with pure cultures in other lots, was for the purpose of controlling the flavor, and proved successful.

Good results will only be attained either way, by dairymen who are competent to make first-class cheese, *as the curing in cans will not correct any error made in preparing the curd.*

ACKNOWLEDGEMENT.—I acknowledge my indebtedness to Prof. F. L. Kent of this Station for his assistance and untiring patience in making the cheeses for this experiment.

Sci 1637.15.3
A Green.

6000.



Bulletin No. 79.

DEPARTMENT OF CHEMISTRY.

Oregon Agricultural Experiment Station.

CORVALLIS, OREGON.

PLANT-FOOD AND USE OF FERTILIZERS.

By A. L. KNISELY.

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Plant-Food and Use of Fertilizers.

BY A. L. KNISELY.

Judging from the correspondence received by the Station Chemist, there is a great desire on the part of the people throughout the state to know about soils, plant-foods and fertilizers, which goes to show that the farmer is seeking information along these lines. Many of the letters ask straightforward questions, but it is impossible to answer them satisfactorily. The following extract is a fair sample of many letters received:

"Oregon Experiment Station, Corvallis, Oregon:

DEAR SIR:—I send you this day, under separate cover, a sample of soil. Will you please analyze and tell me what it will produce in paying quantities in this climate, or if there is any chemical lacking which could be supplied at a reasonable cost to make it first-class land," etc.

The object of this bulletin is to furnish popular information concerning such questions as those asked in the foregoing letter.

Questions relating to the fertility of the soil are very hard to answer and many times definite satisfactory answers cannot be given.

Soils are Very Complex.—The soils of no two farms are alike—neither are the soils of two fields on the same farm exactly alike. The total plant-food in one field differs from that of the adjoining field; the amount of decaying organic matter (humus) differs in different fields; the degree of coarseness or fineness of the soil particles varies greatly; the moisture conditions of no two fields are identical; neither are other physical conditions, nor texture of the soil exactly alike in two different fields—and so on with an almost infinite number of conditions, each having more or less influence upon the fertility or productivity of the soil, each having its influence upon plant growth.

Law of the Minimum.—Since so many conditions surround and influence the growth of a plant it is important to find out which ones affect the growth of the plant most. It has been found by experimentation that it is not the *most favorable* conditions but the *most unfavorable* ones which have the greatest influence upon the growth

NOTE.—The material in this bulletin is arranged to meet the wants of Oregon farmers and is in a way an answer to the many letters concerning fertilizers received at the Experiment Station. The analytical data have been obtained from various sources, chiefly from the U. S. Department of Agriculture and experiment stations, and from work done at this Station.

of a plant. There may be one hundred conditions favorable for plant growth, and five or even one, only, which is unfavorable. It is not the many favorable conditions but the few unfavorable ones which influence the growth of the plant, or crop.

If a field is unproductive on account of poor drainage or because of a lack of humus, it would not be made more productive by adding commercial fertilizer. On the other hand, if a field is unproductive, due to a lack of available plant-food, then the addition of fertilizers will increase its productivity.

The essential conditions of a field which are the poorest or at the lowest ebb must be sought out and improved before the fertility of the field is increased.

It happens many times that poor yields are not due at all to a lack of plant-food, but are due to essential conditions other than those of plant-food.

Plant-food.—There are known to exist and the scientist recognizes about seventy-seven or seventy-eight different elements or simple substances. These elements are not all necessary, but a certain few are indispensable to plant growth. The elements which are necessary and without which plants cannot flourish are known as the plant-food elements. Authorities differ as to the number of elements which are essential for plant growth—some give nine or ten, others twelve and even fourteen. At the very outside, of all the elements known to exist, only twelve or fourteen are necessary for plant growth.

The plant-food elements are as follows: Carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, chlorine, potassium, calcium, iron, magnesium, silicon, sodium and manganese.

Some authorities question the necessity of manganese and sodium.

Carbon, Hydrogen and Oxygen make up the largest part of the woody structure of the plant, the carbohydrates and organic acids.

Nitrogen, Sulphur and also **Carbon, Hydrogen and Oxygen** are necessary for the development of the proteid compounds in the plant.

Phosphorus.—This element in the plant exists in the form of phosphates and is found in all parts of the plant. It seems to have something to do with the development of the proteid substances in plants. Much phosphorus seems to be necessary and it accumulates in the seed of plants.

Chlorine.—The exact function of this element in plants is not definitely known. It is supposed by some authorities to have some-

thing to do with the translocation of starch from the leaf to other parts of the plant.

Potassium.—Compounds of this element are quite widely distributed in the various parts of the plant. They seem to be necessary for the formation and translocation of starch in the plant. Potash is always found in large quantities in the ash of plants.

Calcium.—This element in some form is found in all parts of the plant. It always exists in large quantities in the ash of plants. Calcium seems to be necessary for the growth of the cell structure, that is, for the formation of cellulose out of starch which has been formed in the leaves.

Iron.—Experiments have proven that iron in some form is absolutely necessary for the development of Chlorophyl, which is the green coloring matter in the leaves of plants. In the absence of iron the leaves become yellow and even die, due to the non-development of the chlorophyl grains.

Magnesium.—This element seems to take part in the development of chlorophyl in plants, and also has something to do with the translocation of proteid bodies in the plant.

Silicon.—It is still a mooted question as to whether this element is necessary for plant growth or not. At one time it was supposed that this element gave stiffness and strength to the stems of plants but this belief is being discarded. It is believed by some that Silicon helps in the development and formation of seeds.

Sodium and Manganese.—These elements are not supposed to perform any necessary function in the growth of plants, even though they have generally been classed with the plant-food elements. Manganese is many times and sodium always, found present in the ash of plants.

Sodium is very much cheaper than potassium, and there has been much discussion as to the use of sodium instead of potassium compounds for plants. Sodium cannot be used instead of, or to replace, any of that potash which is required for the normal development of the plant.

Of all the foregoing elements of plant-food, only three or four are included when the subject of fertilizers is considered. These are nitrogen, phosphoric acid, potash, and sometimes lime (calcium oxide.) The remaining plant-food elements are usually present in such abundance that they are not even discussed.

Poor Crops.—When a farmer writes that his soil is unproductive

and that he harvests only one quarter of a crop, and wants to know wherein the trouble lies, a very difficult problem is presented. The poor yield may be due to a lack of available nitrogen, phosphoric acid, potash or lime, or it may be due to the poor character, or low ebb, of one or more of the many other essential conditions which surround and influence the growth of the crop.

Questioning the Soil.—The farmer may question the chemist, or he may question the soil. I believe it is usually more satisfactory to ask the soil questions providing it can be done in an intelligent, systematic manner. The chemist may analyze the soil carefully, and tell to the thousandth part of one per cent. just how much nitrogen, phosphoric acid, potash and lime the soil contains, but he cannot tell absolutely by present methods how much of this plant-food is available for plant growth. Even though the chemist cannot determine accurately the available plant-food, still it is of much value and interest to know the total amount contained in the soil. Analysis may show 0.20 per cent. or approximately 7,000 lbs. nitrogen (N); 0.30 per cent. or approximately 10,500 lbs. phosphoric acid (P_2O_5); 0.50 per cent. or approximately 17,500 lbs. total potash (K_2O) in the surface foot per acre. Much of this plant-food may or may not be available for a growing crop.

If an old, rusty safe, with doors locked, fell into the hands of a farmer and if he knew that this safe contained \$10,000, it would be a great incentive to try to unlock the safe and utilize the money. So also if a farmer has his soil analyzed and finds that it contains 30,000 to 40,000 pounds of plant-food per acre, even if not available, this fact should be worth much to the farmer because it should give him a strong incentive to try and farm in such a way as to gradually make available for his crops this vast amount of plant-food which is locked up in his soil. This plant-food in the soil is the farmer's capital, or money just as much as the \$10,000 in the old, rusty safe.

A farmer can tell if his poor crops are due to a lack of available plant-food by questioning the soil in the following manner: Suppose the farmer plans to grow a cultivated crop in a ten acre field. In the spring lay out several experimental plats on a typical part of the field. Let each plat be one rod wide and eight rods long, that is, one twentieth of an acre. Apply the different plant-foods to these plats and study the effects.

The simplest set of fertilizer experiments would be the following:

8 RODS LONG.

1 rod wide.....	15 pounds nitrate of soda.
1 rod wide.....	30 pounds acid phosphate.
1 rod wide.....	15 pounds muriate of potash.
1 rod wide.....	Blank; no fertilizer.
1 rod wide.....	15 pounds nitrate of soda. 30 pounds acid phosphate. 15 pounds muriate of potash.
1 rod wide.....	$\frac{1}{2}$ ton barnyard manure.

These applications of fertilizers are heavy, but in experimental work it is best to use liberal amounts so that their effects upon the crop can be more easily studied.

The fertilizers should all be applied broadcast upon the plowed ground and cultivated into the soil. The acid phosphate and muriate of potash should be applied to their respective plats as early in the spring as the ground can be prepared for the crop. The nitrate of soda is very soluble and should not be applied until all the heavy rains are over, or until the beginning of the growing season. It would be best to apply only a portion of the nitrate of soda at the first application and the remainder three or four weeks later.

It is advisable to leave a three-foot strip between each two plats as this will prevent the crop growing on one plat from feeding upon the fertilizer applied to the adjoining plat. If this is done the crop on the whole plat may be harvested and this yield multiplied by twenty would give the yield per acre. On the other hand, if no strip is left between each two plats, then the crop growing on the borders of the plats may be getting the effects of the fertilizers from the two plats. In such cases, harvest the crop on a strip one-half rod wide, lengthwise through the centre of each plat; the yield thus obtained multiplied by forty would give the yield per acre.

Experimental plats similar to the foregoing might be tried with any cultivated crop like corn, or potatoes or with a sowed crop, like wheat or oats; also upon small fruits or tree fruits or hop vineyards. If a farmer conducts such a set of experiments and studies it carefully through the growing season and at harvest time carefully estimates the yield per acre for each plat, he may learn much concerning that particular field in which the experiments were tried.

A more elaborate set of experiments than the foregoing and one that contains all the possible combinations of plant-food may be illustrated by the following:

8 Rods Long.

1 rod wide.....	15 pounds nitrate of soda.
1 rod wide.....	30 pounds acid phosphate.
1 rod wide.....	15 pounds muriate of potash.
1 rod wide.....	15 pounds nitrate of soda. 30 pounds acid phosphate.

8 RODS LONG.

1 rod wide.....	Blank; no fertilizer.
1 rod wide.	15 pounds nitrate of soda. 15 pounds muriate of potash.
1 rod wide.....	30 pounds acid phosphate. 15 pounds muriate of potash.
1 rod wide.....	15 pounds nitrate of soda. 30 pounds acid phosphate. 15 pounds muriate of potash.
1 rod wide.....	$\frac{1}{4}$ ton barnyard manure.

A set of fertilizer experiments like this last might be made a little more extensive by adding another plat and applying land-plaster or lime. Another plan would be to sow land-plaster or lime upon half of each small experimental plat. In so doing we could ascertain the effects, upon the crop, of the fertilizers with and without land-plaster or lime.

If, after the crop has been harvested in the fall, the farmer finds that the yield on the blank plat is about as large as upon the plats that were fertilized then it would be folly to buy fertilizers and apply them to that field. On the other hand, it might be that the plats receiving the nitrate of soda give the largest yield, then the probability is that the field lacks available nitrogen. If the plat receiving barnyard manure gives results far better than any of the commercial fertilizer plats, then in all probability the physical con-

dition of the soil needs repairing. The soil needs loosening—needs more decaying organic matter or humus.

Many times these fertilizer experiments will answer the questions of the farmer much better than can a chemist who makes a chemical analysis of the soil.

A farmer after having determined to his satisfaction which elements of plant-food are beneficial, must next ascertain what quantities can be used most profitably. The fact that the effects of applications of phosphoric acid and potash compounds may extend over more than one year must be taken into account when the value of these fertilizers is considered. Their effects may in some cases be seen upon the following crops for several years.

When nitrogen in the form of nitrate is applied most of the effect must be obtained the same year, because any nitrate not used by the crop will in most cases leach out of the soil before the succeeding crop is grown.

Soils Make Plant-Food Insoluble.—When fertilizers are applied to the soil, even though they contain much water-soluble plant-food, there is but little danger of loss by leaching from the soil. Soils with but few exceptions contain those elements which are necessary for the fixation of plant-food. Exceedingly sandy soils do not have the power of fixing or making insoluble the plant-food which is applied in fertilizers. Most soils, however, contain enough of those materials such as lime, iron, aluminum, zeolites and organic matter, which combine with the soluble plant-food applied in fertilizers and make it insoluble so that it does not leach from the soil. Even though it is rendered insoluble in water and hence leaches from the soil only in very small quantities, it is still available to the feeding rootlets of the growing crop.

Generally speaking, all forms of phosphoric acid and potash are fixed in the soil; nitrogen (with the exception of nitrates), which is contained in stable manure and other organic substances, and also nitrogen in the form of ammonia compounds is fixed in the soil.

The fixation of the potash and ammonia compounds is brought about by the so-called zeolites in the soil. The phosphoric acid compounds are fixed in the soil by compounds of lime, iron, aluminum and possibly magnesium. The exceptions to the above are, 1st, that all forms of soluble plant-food tend to leach out of very sandy soils. 2d, that nitrogen in the form of nitrate tends to leach out of all kinds of soils.

FERTILIZERS.

Fertilizers may be complete or incomplete; direct or indirect.

A **Complete Fertilizer** is one that contains each of the three elements of plant-food, nitrogen, phosphoric acid and potash.

An **Incomplete Fertilizer** is one that contains only one or two of the three elements, nitrogen, phosphoric acid and potash.

A **Direct Fertilizer** is one that contains any or all of the three plant-food elements, nitrogen, phosphoric acid and potash. A direct fertilizer is used for the plant-food which it contains.

An **Indirect Fertilizer** is one that does not contain nitrogen, phosphoric acid or potash. An indirect fertilizer is not applied for the purpose of adding plant-food to the soil but in order to make some of the plant-food already in the soil more available. The chief indirect fertilizers are land-plaster, lime and common salt.

Land-plaster, gypsum or calcium sulphate. These are different names for the same compound. Gypsum or land-plaster is nothing more than the sulphate of lime rock which has been ground exceedingly fine.

Quicklime and calcium carbonate. When limestone is burned the resulting product is calcium oxide or quicklime, sometimes called stone-lime. When exposed to the air it becomes air-slaked and is then calcium carbonate or carbonate of lime.

SOURCES OF FERTILIZING MATERIALS.**Nitrogen Supply.**

The following materials are used in this country as sources of nitrogen supply. Some of them, of course, are used much more than others:

	Average per cent Nitrogen	Pounds of Nitrogen in one ton of material	Becomes available
Ammonite (azotine)	10 to 14	200 to 280	Quickly
Castor bean pomace	5 to 6	100 to 120	Moderately fast
Cotton-seed meal	6 to 7	120 to 140	Moderately fast
Dried blood, high-grade	12 to 15	240 to 300	Quickly
Dried blood, low-grade	6 to 12	120 to 240	
Guano	6 to 8	120 to 160	Gradually
Dried fish	7 to 8	140 to 160	Quickly
Horn and hoof waste	10 to 15	200 to 300	Slowly
Leather scraps and meal	7 to 10	140 to 200	Very slowly
Meat scraps	10 to 13	200 to 260	Quickly
Nitrate of potash	13 to 14	260 to 280	Immediately
Nitrate of soda	15 to 16	300 to 320	Immediately
Oleomargarine refuse	10 to 12	200 to 240	Gradually
Sulphate of ammonia	19 to 20	380 to 400	Very quickly
Tankage	6 to 12	120 to 240	Quickly
Tobacco stems	2 to 3	40 to 60	Gradually
Wool waste (untreated)	5 to 6	100 to 120	Very slowly

Ammonite, Azotine as it is sometimes called, **Dried Blood, Horn and Hoof Waste, Leather and Meat Scrap, Oleomargarine Refuse, Tankage and Wool Waste** are all by-products coming from packing houses and rendering establishments.

Castor Bean Pomace is the residue left after separating castor oil from the bean.

Cotton-Seed Meal is the dried residue left after separating the oil from the cotton seed.

Dried Fish is the dried and ground refuse from fish-oil works.

Guano is a rich nitrogenous manure obtained from rainless regions. The supply is nearly exhausted.

Nitrate of Soda (Chili saltpeter) is a mineral substance obtained along the western coast of South America. The world's supply of nitrate of soda comes from this region.

Potassium Nitrate or true saltpeter comes largely from India. This material is so valuable that little or none of it is used as fertilizer.

Tobacco Stems, as the name indicates, is refuse and waste material from tobacco and cigar factories.

Sulphate of Ammonia is a by-product obtained during the manufacture of illuminating gas and coke, also during the manufacture of bone-black.

PHOSPHORIC ACID SUPPLY.

Phosphoric acid in the agricultural sense may be classed as soluble, reverted and insoluble also as available, not available and total.

Soluble Phosphoric Acid is often called mono-calcium phosphate, acid phosphate, or superphosphate. These are all readily soluble in water and easily available for plant growth.

Reverted Phosphoric Acid, also called citrate-soluble phosphoric acid includes that phosphoric acid which is not soluble in water but which is soluble in ammonium citrate solution. It is called reverted because at one time it was water-soluble but has since changed back or reverted into an insoluble form. Reverted phosphoric acid is often called di-calcium phosphate. This form of phosphoric acid even though insoluble in water is still easily available for plant growth.

There is found in Thomas slag a form of phosphoric acid known as tetra-calcium phosphate. This, in many respects, is similar to ordinary reverted or di-calcium phosphate. It is insoluble in water, but much more easily soluble than tri-calcium phosphate and is largely available for plant growth.

SOURCES OF PHOSPHORIC ACID.

	Per cent Phosphoric Acid			Pounds available phosphoric acid in 1 ton of material	Insoluble per cent	Total Phos. Acid		Becomes available
	Soluble	Reverted	Available			Per cent	Lbs. per ton of material	
Apatite.....					83-40	82-40	660-800	Slowly
Bone ash.....					28-35	28-35	580-700	Slowly
Bone black.....					25-36	26-36	500-720	Slowly
Bone black (dissolved).....					1-2	13-20	280-400	Immediately
Bone meal (raw).....	11-15	1-3	12-18	240-380	16-17	20-25	400-500	Slowly
Bone meal (dissolved).....	1/2-1	3 1/2-7	4-8	80-180	3-6	15-20	300-400	Immediately
Bone meal (free from fat).....	10-12	1-2	11-14	220-280	18-22	18-22	360-440	Slowly
Bone meal (from glue factory).....					16-20	22-28	440-560	Slowly
Bone tankage.....			6-8	120-160		10-20	200-400	Slowly
Florida rock.....						25-35	500-700	Slowly
Florida soft phosphate.....						18-30	380-600	Slowly
South Carolina rock (ground).....						25-30	500-600	Slowly
South Carolina rock (bats).....						25-30	500-600	Slowly
South Carolina rock (dissolved).....	9-12	1-4	10-16	200-320	1-3	12-18	240-360	Immediately
Thomas slag.....		3-7	3-7	60-140	12-13	15-20	300-400	Slowly

Insoluble Phosphoric Acid is the ordinary tri-calcium phosphate. This form is very insoluble in water and is but very slowly available for plant growth.

Available Phosphoric Acid consists of the water-soluble and reverted taken together.

Unavailable Phosphoric Acid consists of tri-calcium phosphate, or that portion not included in water-soluble or reverted.

Total Phosphoric Acid is the sum of the available and unavailable phosphoric acid.

Apatite. Considerable apatite has been mined in Canada. It is not very uniform in composition and not so desirable as some other forms of phosphoric acid.

Bone Ash is the residue left after burning bones. Some of this is imported from South America.

Bone-Black or Bone-Charcoal is obtained from sugar refining establishments where it has been used in purifying syrups and sugars.

Bone-Black (dissolved) is similar to ordinary bone-black, except that it has been treated with sulphuric acid so that the phosphoric acid is made more easily available.

Bone Meal consists of ground bones from packing establishments and glue works. Generally the finer the meal the more easily the phosphoric acid becomes available.

Bone Meal (dissolved) consists of bone meal which has been treated with sulphuric acid.

Florida and South Carolina Rock, sometimes called rock phosphates, are mined in large quantities in South Carolina and Florida. The availability of the phosphoric acid contained in these materials depends somewhat upon the degree of fineness to which the substance is ground.

Dissolved Rock, Acid Phosphate or Superphosphate is prepared by treating the ground rock with sulphuric acid. This treatment makes the phosphoric acid much more easily available. The action of the sulphuric acid is to change most of the tri-calcium phosphate contained in the rock to mono-calcium phosphate. During this chemical change much calcium sulphate (gypsum) is formed, so that dissolved rock or acid phosphate always contains about 50 per cent. gypsum.

Thomas Slag is a waste product obtained during the manufacture of Bessemer steel. The slag which accumulates while the steel is being made is rich in phosphoric acid. This slag when finely

ground is used; especially in Europe, in large quantities as a fertilizer.

POTASH SUPPLY.

There are many materials which contain quite large quantities of potash. In the agricultural sense, that potash is considered of most value which is soluble in distilled water. At the present time the main part of the world's supply of potash comes from the mines in Germany.

Potash is usually applied either in the form of muriate, sulphate or carbonate.

The muriate is probably most often used as it is generally somewhat cheaper than other forms. Sometimes for certain crops it is preferable to use the sulphate. In a very few instances the carbonate is used in preference to either muriate or sulphate.

SOURCES OF POTASH.

	Per cent potash (K ₂ O)	Pounds potash in 1 ton of material	Becomes available
Ashes (cotton-seed hull).....	15 to 25	300 to 500	Immediately
Ashes (wood, leached).....	1 to 3	20 to 60	"
Ashes (wood, unleached).....	4 to 10	80 to 200	"
Carnallite.....	12 to 14	240 to 280	"
Kainite.....	12 to 16	240 to 320	"
Krugite.....	8 to 10	160 to 200	"
Muriate of potash.....	48 to 52	960 to 1020	"
Nitrate of potash.....	43 to 45	860 to 900	"
Sulphate of potash (low-grade).....	25 to 30	500 to 600	"
Sulphate of potash (high-grade).....	48 to 53	960 to 1060	"
Sulphate of potash and magnesia.....	25 to 30	500 to 600	"
Sylvinite.....	15 to 20	300 to 400	"
Tobacco waste.....	5 to 8	100 to 160	Gradually

Cotton-seed Hull Ashes are obtained in some of the Southern States where the cotton-seed hulls are used as fuel in some of the mills. These ashes, which contain little or no chloride when obtainable, are especially desirable for such crops as tobacco.

Wood Ashes are obtainable wherever wood is burned in large quantities. The potash contained in them is water-soluble and easily leaches out. Wood ashes are excellent as fertilizer and none should be allowed to go to waste.

Carnallite is obtained from the potash mines of Germany. It consists largely of chlorides of potash and magnesium. The crude material also contains small quantities of the sulphates of potash and magnesium.

Kainite is also obtained from Germany. It is rather complex, con-

sisting largely of sulphates and chlorides of potash and magnesium. It usually contains common salt and gypsum.

Krugite comes from Germany. The crude material consists largely of sulphates of potash, magnesium and calcium.

Muriate of Potash as obtained commercially is one of the products of the German potash mines which has been partially purified. It is used very extensively as a fertilizer.

Nitrate of Potash.—The natural source of this material is India. It is very valuable as a fertilizer, but the demands for it in manufacturing operations almost preclude its use in agriculture.

Sulphate of Potash.—Both high- and low-grades are sold in large quantities as fertilizer. Potash in the form of sulphate usually costs more than when bought in the form of muriate. These sulphates of potash are obtained from Germany.

Sulphates of Potash and Magnesia, sometimes called double potash salts, as the name indicates, consists largely of sulphates of potash and magnesia. These double salts are obtained in Germany and are used in considerable quantities as fertilizers.

Sylvinite.—This is rather a low grade of potash coming from Germany. The potash in this substance exists mostly as sulphate and chloride. It also contains large quantities of sodium chloride and some compounds of magnesium.

Tobacco Waste is obtained from certain factories and when ground furnishes a small amount of fertilizer material. The ash from tobacco waste is exceedingly rich in potash, often containing 50 per cent—it is, however, unwise to burn the waste, for in so doing its nitrogen and insecticidal value is destroyed.

FARM MANURES, ASHES AND STRAW.

Many of the Oregon farmers little realize the value of the waste materials which accumulate on the farm. All the waste materials upon the farm contain one or more of the essential elements of plant-food. These plant-foods have certain commercial values which have been adopted by many of the leading experiment stations of the country (see page 18). In reality the trade values of most of the plant-foods in Oregon are somewhat higher than in some of the centrally located Eastern States; notwithstanding this fact, if we assign the Eastern trade values to the plant-food contained in Oregon farm waste products, we find that they have approximately the following values per ton:

Material	Nitrogen (N) Per cent	Phosphoric acid (P_2O_5) Per cent	Potash (K_2O) Per cent	Value per ton
Horse manure (liquid).....	1.55		1.50	\$ 6.15
Horse manure (solid).....	.51	.22	.44	2.19
Cow manure (liquid).....	.81		.92	3.35
Cow manure (solid).....	.36	.15	.07	1.30
Sheep manure (liquid).....	1.95	.01	2.25	8.12
Sheep manure (solid).....	.74	.27	.41	2.90
Pig manure (liquid).....	.43	.07	.83	2.19
Pig manure (solid).....	.52	.30	.86	3.54
Powis.....	1.19	1.16	.76	5.49
Mixed stable manure.....	.50	.25	.50	2.25
Straw, wheat.....	.53	.17	.57	2.33
Straw, rye.....	.45	.26	.83	2.44
Straw, oat.....	.55	.25	1.35	3.25
Straw, barley.....	.88	.23	1.41	4.13
Ashes, wood.....		1.70	6.00	7.70

According to carefully conducted scientific experiments, the excrement, liquid and solid, from one animal for a year has approximately the following values: Horse, \$22.00 to \$27.00; cow, \$28.00 to \$35.00; sheep, \$2.00 to \$2.50; pig, \$1.00 to \$3.00.

Enormous losses occur annually due to a bad handling of the farm wastes. One of the best methods of caring for farm manures is to haul them out shortly after they have been made and spread them broadcast upon the land. If manure is thrown in piles it many times heats and becomes "fire-fanged." This slow burning of the manure destroys much of its value. The odor of ammonia about the manure heap, indicating a loss of nitrogen, shows that the method of caring for the manure is poor.

The liquid portion of the manure is most valuable and should be saved, and yet the general practice is to pay little or no attention to this portion. It pays to use straw, litter, dry earth, muck or

peat as an absorbent for this valuable liquid portion of the manure. Manure should never be piled under the eaves trough.

Do not burn the straw pile.—It is the custom in many sections of the state to burn the straw in order to get rid of it. By so doing all the nitrogen and organic matter contained in the straw are destroyed and lost to the farmer. These losses represent many thousands of dollars annually. It is far better to use straw as litter and as an absorbent about the barn and sheds as mulching and as a rendezvous for stock where they can pick it over and tramp it to pieces so that it can be more easily handled and worked into the soil.

Wood Ashes.—Every pound of wood ashes which is made on the farm is valuable and should be carefully saved. Do not let it accumulate in open boxes or barrels exposed to the rains, because its valuable constituent, potash, is easily leached out. Keep the ashes dry until ready for use.

It is a bad practice to mix wood ashes with any of the farm manures because the action of the lye in the ashes is to decompose the ammonia compounds of the manure and thus liberate the most valuable plant-food element, nitrogen, in the form of ammonia gas.

Trade Values of Nitrogen, Phosphoric Acid and Potash.—The commercial values of the materials which are used as fertilizers, depend upon several conditions, such as cost of production, supply and demand, etc. It is the custom for the leading experiment stations of the East, to annually adopt a schedule of trade values for nitrogen, phosphoric acid and potash; these prices being governed by the prevailing wholesale prices of the standard materials as shown by the market reports of the commercial centers.

SCHEDULE OF TRADE VALUES ADOPTED BY EXPERIMENT STATIONS.

	Cents per lb.
	1903
Nitrogen in Nitrates.....	15.0
" " Ammonia Salts.....	17.5
Organic Nitrogen in dried and fine-ground fish, meat and blood, and in mixed fertilizers.....	17.0
" " " fine-ground bone and tankage.....	16.5
" " " coarse bone and tankage.....	12.0
Phosphoric Acid, soluble in water.....	4.5
" " " ammonium citrate.....	4.0
" " " insoluble in fine bone and tankage.....	4.0
" " " coarse bone and tankage.....	3.0
" " " mixed fertilizers.....	2.0
" " " fine-ground fish, cotton-seed meal, castor pomace and wood ashes.....	4.0
Potash as Muriate.....	4.25
" " Sulphate, and in forms free from muriates (or chlorids).....	5.0

Owing to distance from Eastern markets, transportation rates and to the small amounts of material used, fertilizers in Oregon at the

present time cost approximately one fifth to one half more than they do in the East.

In Oregon according to the present prices and available material, the probability is that nitrogen can best be bought as nitrate of soda or as fish guano; phosphoric acid in the form of ground bone, acid phosphate, double superphosphate, or Thomas slag; potash as muriate or sulphate of potash. At the present time potash and nitrogen do not cost very much more than they do in the Eastern markets, while phosphoric acid costs much more and in some cases twice as much.

WHEN AND HOW TO APPLY COMMERCIAL FERTILIZERS, FARM MANURE AND ASHES.

There is much uncertainty among farmers as to the manner of applying fertilizers. Generally they should be sown broadcast and cultivated into the soil. The feeding rootlets are not at the base of a tree or plant, but usually are found some distance from the plant where they form a perfect net-work of rootlets in the soil. If fertilizers are applied just at the base of the plant they do but little good and many times much harm.

Nitrogen in the form of nitrate should not be applied until the beginning of the growing season. If applied too early much may be lost by leaching out of the soil before the crop assimilates it. It is many times best to apply the nitrate in two or three partial applications, say one-third at beginning of the growing season, one-third three weeks later and the last third two weeks later.

Other forms of nitrogen may be applied earlier in the Spring.

Phosphoric Acid and Potash compounds may be applied early in the spring, or even during the fall and winter without danger or loss by leaching out of the soil (except on very sandy soils).

It is best to apply those phosphates that contain much water-soluble phosphoric acid early in the spring, for if applied in the fall the phosphoric acid tends to revert and become insoluble. Many times when potash is applied it tends to become fixed near the surface of the soil; it is better, therefore, to apply it early in the spring and as soon as the ground is dry enough to work thoroughly cultivate it into the soil.

Farm Manures may be applied any time during the fall, winter or

early spring broadcast upon the land. The time and manner of application is governed largely by the crop or plants for which it is used.

Wood Ashes may be applied any time during fall or winter. They are especially valuable for bushes, small fruits and tree fruits about the garden. Do not apply at base of plants but spread broadcast about the plants. The ashes work into the soil very slowly, so it is very helpful many times to spade them into the ground.

Land-Plaster when used upon land should be sown broadcast very early in spring or during the winter because it works into the soil very slowly. Good success is obtained in Oregon by using 50 to 100 lbs. of plaster per acre. Better results are usually obtained by using plaster upon deep rooted leguminous plants rather than upon shallow rooted non-leguminous plants.

EFFECT OF FERTILIZER.

In the use of fertilizing materials, nitrogen tends to stimulate leaf growth. An abundance of nitrogen in the soil is indicated by rank luxuriant growth and dark green foliage. Too much nitrogen on vines, shrubs and trees cause a too rapid growth of wood. The wood thus formed is rather tender, soft and does not ripen properly and is often injured by the winter weather. An excessive use of nitrogen stimulates leaf and wood growth at the expense of fruit.

Phosphoric acid and potash have more to do with the development of fruit buds, fruit and seed; they also produce a more normal development of the parts of the plant, the parts are firmer, the wood ripens better and is more hardy.

FERTILIZERS FOR DIFFERENT CROPS.

In the following pages are given approximately, the amount of nitrogen, phosphoric acid and potash which it seems advisable to use on various farm crops. Many times, depending upon local conditions, the amounts of plant-food indicated may be profitably diminished or increased.

The intelligent farmer should always satisfy himself that he can buy and use fertilizers profitably before he invests very largely.

In the following pages only a few materials are indicated as furnishing plant-food. If other materials can be obtained more cheaply then use them instead.

ALFALFA.

Relative proportions available plant-food.		Pounds material for one acre.	
Pounds per acre.			
Nitrogen.....	10 to 20	50 to	120 nitrate of soda; or
		50 to	100 sulphate of ammonia; or
		150 to	800 fish guano; or
		2000 to	4000 stable manure.
		240 to	480 acid phosphate; or
Phosphoric acid.....	30 to 60	75 to	150 double superphosphate; or
		300 to	600 ground bone.
		150 to	300 muriate of potash; or
Potash	75 to 150	150 to	300 sulphate of potash; or
		600 to	1200 kainite; or
		1500 to	3000 wood ashes.

Alfalfa is a leguminous plant and under certain conditions has the power of assimilating atmospheric nitrogen and, many times, application of nitrogen may be dispensed with. Land-plaster at the rate of 50 to 100 pounds per acre is usually followed by very beneficial results. This crop requires considerable lime and many times this material may be applied profitably not only because it furnishes lime to the plant, but because it destroys the acidity of the soil which is injurious to leguminous plants.

Examine the alfalfa roots; if nodules are growing upon them, then use very little nitrogen; if no nodules are found, the application of nitrogen should be increased considerably, also inoculate the field with soil from an alfalfa patch which has an abundance of nodules on the roots.

Stable manure is probably the best fertilizer to use owing to its beneficial effect upon the physical condition and bacterial activity of the soil.

APPLES (Trees Over 10 Years Old).

Relative proportions available plant-food..		Pounds material for one acre.	
Pounds per acre.			
Nitrogen.....	8 to 16	50 to	100 nitrate of soda; or
		40 to	80 sulphate of ammonia; or
		120 to	240 fish guano; or
		1600 to	3200 stable manure.
		240 to	480 acid phosphate; or
Phosphoric acid.....	30 to 60	75 to	150 double superphosphate; or
		300 to	600 ground bone.
		100 to	200 muriate of potash; or
Potash	50 to 100	100 to	200 sulphate of potash; or
		400 to	800 kainite; or
		1000 to	2000 wood ashes.

Do not apply at base of tree but sow broadcast. Generally slow-acting forms of fertilizers are cheaper and desirable to use. Wood ashes are excellent for apple trees. Care should be taken not to use an excess of nitrogen. The cheapest and best way to add nitrogen to the orchard soil is to grow leguminous crops such as vetch, crimson clover, or peas and plow under when they attain medium height.

In this way both nitrogen and humus are added to the soil and its texture improved.

APRICOTS (Trees Over 5 Years Old).

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen.....10 to 20	60 to 120 nitrate of soda; or 50 to 100 sulphate of ammonia; or 150 to 300 fish guano; or 2000 to 4000 stable manure.
Phosphoric acid.....30 to 60	240 to 480 acid phosphate; or 75 to 150 double superphosphate; or 300 to 600 ground bone.
Potash.....45 to 90	90 to 180 muriate of potash; or 90 to 180 sulphate of potash; or 360 to 720 kainite; or 900 to 1800 wood ashes.

Sow broadcast in all cases. If trees are making vigorous growth and foliage is dark and luxuriant, the amount of nitrogen should be diminished. It is advisable to use some leguminous cover crop as a means of adding nitrogen and humus to the soil.

ARTICHOKES (Jerusalem).

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen.....15 to 30	90 to 180 nitrate of soda; or 75 to 150 sulphate of ammonia; or 225 to 450 fish guano; or 8000 to 6000 stable manure.
Phosphoric acid.....36 to 72	290 to 580 acid phosphate; or 90 to 180 double superphosphate; or 360 to 720 ground bone.
Potash.....50 to 100	100 to 200 muriate of potash; or 100 to 200 sulphate of potash; or 400 to 800 kainite; or 1000 to 2000 wood ashes.

Artichokes are hardy, rank growers and since their period of growth extends over several months, the cheaper, less active form of plant-food may be profitably used.

ASPARAGUS.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen.....45 to 90	270 to 540 nitrate of soda; or 225 to 450 sulphate of ammonia; or 675 to 1350 fish guano; or 9000 to 18000 stable manure.
Phosphoric acid.....35 to 70	280 to 560 acid phosphate; or 85 to 170 double superphosphate; or 350 to 700 ground bone.
Potash.....50 to 100	100 to 200 muriate of potash; or 100 to 200 sulphate of potash; or 400 to 800 kainite; or 1000 to 2000 wood ashes.

It is a good plan to apply part of the plant-food early in the spring in immediately available forms such as nitrate of soda, acid

phosphate and muriate of potash. Apply the remainder in more slowly available forms such as fish guano, ground bone and kainite. Stable manure applied in fall or winter gives excellent results.

BARLEY.

Relative proportions available plant-food.		Pounds per acre.		Pounds material for one acre.	
Nitrogen.....	12 to 24	{	75 to	150 nitrate of soda; or	
			60 to	120 sulphate of ammonia; or	
			180 to	360 fish guano; or	
			2400 to	4800 stable manure.	
Phosphoric acid.....	20 to 40	{	160 to	320 acid phosphate; or	
			50 to	100 double superphosphate; or	
			200 to	400 ground bone.	
Potash.....	25 to 50	{	50 to	100 muriate of potash; or	
			50 to	100 sulphate of potash; or	
			200 to	400 kainite; or	
			500 to	1000 wood ashes.	

BEANS.

Relative proportions available plant-food.		Pounds per acre.		Pounds material for one acre.	
				60 to	120 nitrate of soda; or
				50 to	100 sulphate of ammonia; or
Nitrogen	.....	10 to 20	{	150 to	300 fish guano; or
				2000 to	4000 stable manure.
				320 to	640 acid phosphate; or
Phosphoric acid	.....	40 to 80		100 to	200 double superphosphate; or
				400 to	800 ground bone.
			{	100 to	200 muriate of potash; or
				100 to	200 sulphate of potash; or
Potash	.....	50 to 100		400 to	800 kainite; or
				1000 to	2000 wood ashes.

Beans are leguminous plants. If the nitrogen-gathering bacteria (indicated by nodules on the roots) are present in the soil, then the application of nitrogen may be greatly reduced, or dispensed with entirely. If grown as string beans, the quantity of nitrogen used may sometimes be profitably increased.

BEETS.

Relative proportions available plant-food.		Pounds per acre.		Pounds material for one acre.	
				180 to	360 nitrate of soda; or
				150 to	300 sulphate of ammonia; or
Nitrogen.....	30 to 60	{	450 to	900 fish guano; or	
			6000 to	12000 stable manure.	
Phosphoric acid	60 to 120	{	480 to	960 acid phosphate; or	
			150 to	300 double superphosphate; or	
Potash.....	75 to 150	{	600 to	1200 ground bone.	
			150 to	300 muriate of potash; or	
				150 to	300 sulphate of potash; or
				600 to	1200 kainite; or
				1500 to	3000 wood ashes.

It is advisable to apply the nitrate of soda in two or three partial applications. Some authorities advise using potash in form of sulphate, especially when the beets are grown for sugar.

BLACKBERRIES.

Relative proportions available plant-food.		Pounds material for one acre.
	Pounds per acre.	
Nitrogen.....	15 to 30	90 to 180 nitrate of soda; or
		75 to 150 sulphate of ammonia; or
		225 to 450 fish guano; or
		8000 to 6000 stable manure.
Phosphoric acid.....	25 to 50	200 to 400 acid phosphate; or
		65 to 130 double superphosphate; or
		250 to 500 ground bone.
		100 to 200 muriate of potash; or
Potash.....	50 to 100	100 to 200 sulphate of potash; or
		400 to 800 kainite; or
		1000 to 2000 wood ashes.

BROCCOLI.

Relative proportions available plant-food.		Pounds material for one acre.
	Pounds per acre.	
Nitrogen.....	40 to 80	240 to 480 nitrate of soda; or
		200 to 400 sulphate of ammonia; or
		600 to 1200 fish guano; or
		8000 to 16000 stable manure.
Phosphoric acid.....	70 to 140	560 to 1120 acid phosphate; or
		175 to 350 double superphosphate; or
		700 to 1400 ground bone.
		180 to 360 muriate of potash; or
Potash.....	90 to 180	180 to 360 sulphate of potash; or
		720 to 1440 kainite; or
		1800 to 3600 wood ashes.

Best results are obtained by applying a portion of the fertilizers in immediately available forms and the remainder in forms which gradually become available during the growing season.

Brussels Sprouts.—Fertilizers same as for broccoli.

BUCKWHEAT.

Relative proportions available plant-food.		Pounds material for one acre.
	Pounds per acre.	
Nitrogen.....	12 to 24	75 to 150 nitrate of soda; or
		60 to 120 sulphate of ammonia; or
		180 to 360 fish guano; or
		2400 to 4800 stable manure.
Phosphoric acid.....	25 to 50	200 to 400 acid phosphate; or
		65 to 130 double superphosphate; or
		250 to 500 ground bone.
		60 to 120 muriate of potash; or
Potash.....	30 to 60	60 to 120 sulphate of potash; or
		240 to 480 kainite; or
		600 to 1200 wood ashes.

Cabbage.—Fertilizers same as for broccoli.

Carrots.—Fertilizers same as for beets.

CASTOR BEAN.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen.....8 to 16	50 to 100 nitrate of soda; or 40 to 80 sulphate of ammonia; or 120 to 240 fish guano; or 1600 to 3200 stable manure.
Phosphoric acid.....32 to 64	250 to 500 acid phosphate; or 80 to 160 double superphosphate; or 320 to 640 ground bone.
Potash.....32 to 64	65 to 130 muriate of potash; or 65 to 130 sulphate of potash; or 250 to 500 kainite; or 650 to 1300 wood ashes.

Caniflower.—Fertilizers same as for broccoli.

CELERY.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen.....60 to 120	360 to 720 nitrate of soda; or 300 to 600 sulphate of ammonia; or 900 to 1800 fish guano; or 12000 to 24000 stable manure.
Phosphoric acid.....120 to 240	960 to 1920 acid phosphate; or 300 to 600 double superphosphate; or 1200 to 2400 ground bone.
Potash.....150 to 300	300 to 600 muriate of potash; or 300 to 600 sulphate of potash; or 1200 to 2400 kainite; or 3000 to 6000 wood ashes.

Celery thrives best in soil rich in decaying organic matter such as muck or beaver-dam. Many of the Oregon beaver-dam and swamp soils are exceedingly rich in nitrogen; therefore when celery is grown upon such soils the amount of nitrogen to be applied may be greatly reduced.

Cherries.—Fertilizers same as for apricots, except that the addition of a few hundred pounds of lime either in the form of air-slacked lime or wood ashes is very beneficial.

CHICORY.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen.....30 to 60	180 to 360 nitrate of soda; or 150 to 300 sulphate of ammonia; or 450 to 900 fish guano; or 6000 to 12000 stable manure.
Phosphoric acid.....60 to 120	480 to 960 acid phosphate; or 150 to 300 double superphosphate; or 600 to 1200 ground bone.
Potash.....50 to 100	100 to 200 muriate of potash; or 100 to 200 sulphate of potash; or 400 to 800 kainite; or 1000 to 2000 wood ashes.

Clover.—Fertilizers same as for alfalfa.

CORN.

Relative proportions available plant-food.		Pounds material for one acre.
	Pounds per acre.	
Nitrogen	15 to 30	90 to 180 nitrate of soda; or
		75 to 150 sulphate of ammonia; or
		225 to 450 fish guano; or
		3000 to 6000 stable manure.
Phosphoric acid.....	30 to 60	240 to 480 acid phosphate; or
		75 to 150 double superphosphate; or
		800 to 600 ground bone.
		80 to 160 muriate of potash; or
Potash.....	40 to 80	80 to 160 sulphate of potash; or
		820 to 640 kainite; or
		800 to 1600 wood ashes.

Nitrogen applied in the form of stable manure is especially beneficial as a dressing for corn ground. If corn is grown for fodder or for eating and canning purposes, the amount of stable manure, or nitrogenous fertilizer applied may be increased.

CRANBERRIES.

Relative proportions available plant-food.		Pounds material for one acre.
	Pounds per acre.	
Nitrogen.....	10 to 20	60 to 120 nitrate of soda; or
		50 to 100 sulphate of ammonia; or
		150 to 300 fish guano; or
		2000 to 4000 stable manure.
Phosphoric acid.....	30 to 60	240 to 480 acid phosphate; or
		75 to 150 double superphosphate; or
		800 to 600 ground bone.
		100 to 200 muriate of potash; or
Potash.....	50 to 100	100 to 200 sulphate of potash; or
		400 to 800 kainite; or
		1000 to 2000 wood ashes.

Cranberries grow best on low swamps, or bog-lands rich in decaying organic matter. These lands usually are excessively rich in nitrogen, but poorer in phosphoric acid and potash so that fertilizers should be applied accordingly. Many times, applications of nitrogenous materials are entirely unnecessary.

CUCUMBERS.

Relative proportions available plant-food.		Pounds material for one acre.
	Pounds per acre.	
Nitrogen.....	30 to 60	180 to 360 nitrate of soda; or
		150 to 300 sulphate of ammonia; or
		450 to 900 fish guano; or
		6000 to 12000 stable manure.
Phosphoric acid.....	45 to 90	360 to 720 acid phosphate; or
		110 to 220 double superphosphate; or
		450 to 900 ground bone.
		130 to 260 muriate of potash or
Potash.....	65 to 130	130 to 260 sulphate of potash; or
		620 to 1040 kainite; or
		1300 to 2600 wood ashes.

Well decomposed stable manure is especially beneficial, also nitrogen in form of fish guano. If cucumbers are grown for pickling purposes and if a quick growth is desired, then apply most of the nitrogen in form of nitrate of soda, in several partial applications.

CURRENTS.

Relative proportions available plant-food.	Pounds per acre	Pounds material for one acre.
Nitrogen	10 to 20	60 to 120 nitrate of soda; or 50 to 100 sulphate of ammonia; or 150 to 300 fish guano; or 2000 to 4000 stable manure.
Phosphoric acid	30 to 60	240 to 480 acid phosphate; or 75 to 150 double superphosphate; or 300 to 600 ground bone.
Potash	50 to 100	100 to 200 muriate of potash; or 100 to 200 sulphate of potash; or 400 to 800 kainite; or 1000 to 2000 wood ashes.

Too much nitrogen produces rapid growth of foliage and the plants become more easily susceptible to disease and mildew. Nitrogen applied in some slow-acting form is usually best.

EGG-PLANT.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	40 to 80	240 to 480 nitrate of soda; or 200 to 400 sulphate of ammonia; or 600 to 1200 fish guano; or 8000 to 16000 stable manure.
Phosphoric acid	60 to 120	480 to 960 acid phosphate; or 150 to 300 double superphosphate; or 600 to 1200 ground bone.
Potash	75 to 150	150 to 300 muriate of potash; or 150 to 300 sulphate of potash; or 600 to 1200 kainite; or 1500 to 3000 wood ashes.

Emmer. (Spelt)—Fertilizers same as for barley.

Endive.—Fertilizers same as for chicory.

FLAX.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	12 to 24	75 to 150 nitrate of soda; or 60 to 120 sulphate of ammonia; or 180 to 360 fish guano; or 2400 to 4800 stable manure.
Phosphoric acid	35 to 70	280 to 560 acid phosphate; or 85 to 170 double superphosphate; or 350 to 700 ground bone.
Potash	40 to 80	80 to 160 muriate of potash; or 80 to 160 sulphate of potash; or 320 to 640 kainite; or 800 to 1600 wood ashes.

Flowers in Garden.—See last page for general instructions in preparing and using fertilizers in the garden.

Flowers in Pots.—At times it becomes desirable to stimulate the growth of plants in pots. Besides using small applications of the water-extract of barnyard manure, the following solution may be prepared and used to advantage. These materials may be obtained at any drug store.

1 ounce sodium nitrate
4 ounces sodium phosphate
2 ounces potassium sulphate
1 gallon water

Keep this solution in glass jars or bottles. Two or three times each week when watering the plants, apply from one teaspoonful to one tablespoonful to each plant, the amount used of course, depending upon the size of the pot and plant.

Gooseberries.—Fertilizers same as for currants.

GRAPES.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen.....25 to 50	150 to 300 nitrate of soda; or 125 to 250 sulphate of ammonia; or 375 to 750 fish guano; or 5000 to 10000 stable manure.
Phosphoric acid 50 to 100	400 to 800 acid phosphate; or 125 to 250 double superphosphate; or 500 to 1000 ground bone.
Potash.....100 to 200	200 to 400 muriate of potash; or 200 to 400 sulphate of potash; or 800 to 1600 kainite; or 2000 to 4000 wood ashes.

Grapes require large quantities of mineral plant-food. Wood ashes are especially valuable as a source of potash and lime. If wood ashes cannot be obtained, several hundred pounds of lime may be applied to advantage every four or five years.

Instead of applying nitrogenous fertilizers, it is the practice in many places to grow crimson clover or other leguminous crops during the fall and spring and plow under. This practice is to be commended since it adds both nitrogen and humus to the soil.

GRASS FOR LAWNS.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen.....20 to 40	120 to 240 nitrate of soda; or 100 to 200 sulphate of ammonia; or 300 to 600 fish guano; or 4000 to 8000 stable manure.
Phosphoric acid.....40 to 80	820 to 640 acid phosphate; or 100 to 200 double superphosphate; or 400 to 800 ground bone.
Potash.....40 to 80	80 to 160 muriate of potash; or 80 to 160 sulphate of potash; or 320 to 640 kainite; or 800 to 1600 wood ashes.

In preparing soil for a lawn use the slow-acting forms of plant-food. After the lawn has become established, use small applications of the more easily available forms of plant-food. Excellent results are obtained by applying 50 to 60 pounds of nitrate of soda two or three times during the growing season.

Lawns that are over-run with moss may be greatly helped by applying, during winter or early spring, heavy coatings of wood ashes. This kills the moss and at the same time stimulates the growth of the grass. Too great an application of potash may also stimulate the growth of clover and so it frequently happens that the application of wood ashes is followed by a heavy growth of clover, providing there are any clover seeds or small plants in the lawn.

GRASS FOR MEADOWS AND PASTURES.

Relative proportions available plant-food. Pounds per acre.		Pounds material for one acre.
Nitrogen.....	20 to 40	120 to 240 nitrate of soda; or
		100 to 200 sulphate of ammonia; or
		300 to 600 fish guano; or
		4000 to 8000 stable manure.
Phosphoric acid.....	20 to 40	160 to 320 acid phosphate; or
		50 to 100 double superphosphate; or
		200 to 400 ground bone.
		100 to 200 muriate of potash; or
Potash.....	50 to 100	100 to 200 sulphate of potash; or
		400 to 800 kainite; or
		1000 to 2000 wood ashes.

It is suggested to apply about half the fertilizer in spring and the remainder after cutting the hay crop. If the field is used for pasture, the amount of nitrogen applied should be diminished and the potash increased.

HEMP.

Relative proportions available plant-food. Pounds per acre.		Pounds material for one acre.
Nitrogen.....	30 to 60	180 to 360 nitrate of soda; or
		150 to 300 sulphate of ammonia; or
		450 to 900 fish guano; or
		6000 to 12000 stable manure.
Phosphoric acid.....	40 to 80	320 to 640 acid phosphate; or
		100 to 200 double superphosphate; or
		400 to 800 ground bone.
		120 to 240 muriate of potash; or
Potash.....	60 to 120	120 to 240 sulphate of potash; or
		480 to 960 kainite; or
		1200 to 2400 wood ashes.

HOPS.

Relative proportions available plant-food.		Pounds per acre.		Pounds material for one acre.	
Nitrogen	.....	20 to 40	{	120 to	240 nitrate of soda; or
				100 to	200 sulphate of ammonia; or
				300 to	600 fish guano; or
				4000 to	8000 stable manure.
Phosphoric acid	.....	50 to 100	{	400 to	800 acid phosphate; or
				125 to	250 double superphosphate; or
				500 to	1000 ground bone.
				200 to	400 muriate of potash; or
Potash	.....	100 to 200	{	200 to	400 sulphate of potash; or
				800 to	1600 kainite; or
				2000 to	4000 wood ashes.

Too much nitrogen may produce a rank growth of foliage at the expense of the hops unless it is properly balanced with phosphoric acid and potash. Hops are exceedingly heavy feeders of potash. Many hop vineyards are becoming less productive and this is in part due to a decrease in the humus of the soil. If some leguminous crop could be sown, as soon as the hops are picked, on a narrow strip between each two rows and then plowed under in the spring it would add both humus and nitrogen to the soil and thus keep up the texture.

HORSE-RADISH.

Relative proportions available plant-food.		Pounds per acre.		Pounds material for one acre.	
Nitrogen	.....	20 to 40	{	120 to	240 nitrate of soda; or
				100 to	200 sulphate of ammonia; or
				300 to	600 fish guano; or
				4000 to	8000 stable manure.
Phosphoric acid	.....	25 to 50	{	200 to	400 acid phosphate; or
				60 to	120 double superphosphate; or
				250 to	500 ground bone.
				100 to	200 muriate of potash; or
Potash	.....	50 to 100	{	100 to	200 sulphate of potash; or
				400 to	800 kainite; or
				1000 to	2000 wood ashes.

Kale.—Fertilizers same as for broccoli.

LETTUCE.

Relative proportions available plant-food.		Pounds per acre.		Pounds material for one acre.	
Nitrogen	.....	35 to 70	{	210 to	420 nitrate of soda; or
				175 to	350 sulphate of ammonia; or
				525 to	1050 fish guano; or
				7000 to	14000 stable manure.
Phosphoric acid	.....	50 to 100	{	400 to	800 acid phosphate; or
				125 to	250 double superphosphate; or
				500 to	1000 ground bone.
				150 to	300 muriate of potash; or
Potash	.....	75 to 150	{	150 to	300 sulphate of potash; or
				600 to	1200 kainite; or
				1500 to	3000 wood ashes.

Lucerne. (Alfalfa)—Fertilizers same as for alfalfa.

CAUTION.—Question the soil thoroughly as suggested on page six before adopting the wholesale use of fertilizers. Much money is unwisely spent in buying and using commercial fertilizers.

Mangel-Wurzel.—Fertilizers same as for beets.

MILLET.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen.....20 to 40	120 to 240 nitrate of soda; or 100 to 200 sulphate of ammonia; or 800 to 600 fish guano; or 4000 to 8000 stable manure.
Phosphoric acid.....20 to 40	160 to 320 acid phosphate; or 50 to 100 double superphosphate; or 200 to 400 ground bone.
Potash.....40 to 80	80 to 160 muriate of potash; or 80 to 160 sulphate of potash; or 320 to 640 kainite; or 800 to 1600 wood ashes.

Since this is a quick growing, shallow rooted crop, best results are obtained when all the plant-food is applied in immediately available forms.

Muskmelons.—Fertilizers same as for cucumbers.

MUSTARD.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen.....10 to 20	60 to 120 nitrate of soda; or 50 to 100 sulphate of ammonia; or 150 to 800 fish guano; or 2000 to 4000 stable manure.
Phosphoric acid.....15 to 30	120 to 240 acid phosphate; or 35 to 70 double superphosphate; or 150 to 300 ground bone.
Potash.....25 to 50	50 to 100 muriate of potash; or 50 to 100 sulphate of potash; or 200 to 400 kainite; or 500 to 1000 wood ashes.

NURSERY STOCK.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen.....15 to 30	90 to 180 nitrate of soda; or 75 to 150 sulphate of ammonia; or 225 to 450 fish guano; or 3000 to 6000 stable manure.
Phosphoric acid.....30 to 60	240 to 480 acid phosphate; or 75 to 150 double superphosphate; or 800 to 600 ground bone.
Potash.....40 to 80	80 to 160 muriate of potash; or 80 to 160 sulphate of potash; or 320 to 640 kainite; or 800 to 1600 wood ashes.

OATS.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen.....10 to 20	60 to 120 nitrate of soda; or 50 to 100 sulphate of ammonia; or 150 to 300 fish guano; or 2000 to 4000 stable manure.
Phosphoric acid.....20 to 40	160 to 320 acid phosphate; or 50 to 100 double superphosphate; or 200 to 400 ground bone.
Potash.....30 to 60	60 to 120 muriate of potash; or 60 to 120 sulphate of potash; or 240 to 480 kainite; or 600 to 1200 wood ashes.

Quick acting forms of plant-food generally give best results.

ONIONS.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen.....40 to 80	240 to 480 nitrate of soda; or 200 to 400 sulphate of ammonia; or 600 to 1200 fish guano; or 8000 to 16000 stable manure.
Phosphoric acid.....50 to 100	400 to 800 acid phosphate; or 125 to 250 double superphosphate; or 500 to 1000 ground bone.
Potash.....90 to 180	180 to 360 muriate of potash; or 180 to 360 sulphate of potash; or 720 to 1440 kainite; or 1800 to 3600 wood ashes.

When onions are grown upon beaver-dam, or rich black soil, the application of nitrogen may be greatly diminished or dispensed with entirely because these soils are many times exceedingly rich in nitrogen.

PARSNIPS.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen.....30 to 60	180 to 360 nitrate of soda; or 150 to 300 sulphate of ammonia; or 450 to 900 fish guano; or 6000 to 12000 stable manure
Phosphoric acid.....50 to 100	400 to 800 acid phosphate; or 125 to 250 double superphosphate; or 500 to 1000 ground bone.
Potash.....80 to 160	160 to 320 muriate of potash; or 160 to 320 sulphate of potash; or 640 to 1280 kainite; or 1600 to 3200 wood ashes.

Peaches.—Fertilizers same as for apricots.

Pears.—Fertilizers same as for apples.

Peas.—Fertilizers same as for beans.

PEPPERS.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen.....30 to 60	180 to 360 nitrate of soda; or 150 to 300 sulphate of ammonia; or 450 to 900 fish guano; or 6000 to 12000 stable manure.
Phosphoric acid.....30 to 60	240 to 480 acid phosphate; or 75 to 150 double superphosphate; or 300 to 600 ground bone.
Potash.....50 to 100	100 to 200 muriate of potash; or 100 to 200 sulphate of potash; or 400 to 800 kainite; or 1000 to 2000 wood ashes.

Best results are obtained when the nitrogen as nitrate of soda is applied in two or three partial applications.

Plants in Pots.—Fertilizers same as for flowers in pots.

PIEPLANT. (Rhubarb)

Relative proportions available plant-food. Pounds per acre.		Pounds material for one acre.
Nitrogen.....	50 to 100	300 to 600 nitrate of soda; or
		250 to 500 sulphate of ammonia; or
		750 to 1500 fish guano; or
		10000 to 20000 stable manure.
Phosphoric acid.....	75 to 150	600 to 1200 acid phosphate; or
		180 to 360 double superphosphate; or
		750 to 1500 ground bone.
		200 to 400 muriate of potash; or
Potash.....	100 to 200	200 to 400 sulphate of potash; or
		800 to 1600 kainite; or
		2000 to 4000 wood ashes.

Well decomposed stable manure worked into the soil gives excellent results. Parts of Oregon have considerable rain in the spring, so that if all the nitrogen is applied early in the season as nitrate of soda, much of it may be lost.

Plums.—Fertilizers same as for apricots.

POTATOES.

Relative proportions available plant-food. Pounds per acre.		Pounds material for one acre.
Nitrogen.....	30 to 60	180 to 360 nitrate of soda; or
		150 to 300 sulphate of ammonia; or
		450 to 900 fish guano.
		480 to 960 acid phosphate; or
Phosphoric acid.....	60 to 120	150 to 300 double superphosphate; or
		600 to 1200 ground bone.
		150 to 300 muriate of potash; or
		150 to 300 sulphate of potash; or
Potash.....	75 to 150	600 to 1200 kainite.

For early potatoes quick-acting forms of plant-food should be used.

For late potatoes the amounts of fertilizers used may be diminished somewhat. The nitrogen may be applied in a slow-acting organic form.

Avoid the use of stable manure or wood ashes immediately before a crop of potatoes is grown. They promote the growth of potato scab. Some advise the use of sulphate rather than the muriate of potash.

Prunes.—Fertilizers same as for apricots.

Pumpkins.—Fertilizers same as for cucumbers.

Quinces.—Fertilizers same as for apples.

RADISHES.

Relative proportions available plant-food. Pounds per acre.		Pounds material for one acre.
Nitrogen.....	20 to 40	120 to 240 nitrate of soda; or
		100 to 200 sulphate of ammonia; or
		300 to 600 fish guano; or
		4000 to 8000 stable manure.
Phosphoric acid.....	40 to 80	320 to 640 acid phosphate; or
		100 to 200 double superphosphate; or
		400 to 800 ground bone.
		100 to 200 muriate of potash; or
Potash.....	50 to 100	100 to 200 sulphate of potash; or
		400 to 800 kainite; or
		1000 to 2000 wood ashes.

RAPE.

Relative proportions available plant food.	Pounds per acre.	Pounds material for one acre.
Nitrogen.....	20 to 40	120 to 240 nitrate of soda; or 100 to 200 sulphate of ammonia; or 300 to 600 fish guano; or 4000 to 8000 stable manure.
Phosphoric acid.....	40 to 80	320 to 640 acid phosphate; or 100 to 200 double superphosphate; or 400 to 800 ground bone.
Potash	40 to 80	80 to 160 muriate of potash; or 80 to 160 sulphate of potash; or 320 to 640 kainite; or 800 to 1600 wood ashes.

Raspberries.—Fertilizers same as for blackberries.

Rhubarb.—See pieplant.

Ruta-bagas.—Fertilizers same as for beets, except that upon this crop, some of the cheaper less available forms of phosphoric acid may be used with good results.

Rye.—Fertilizers same as for oats.

Sainfoin.—Fertilizers same as for alfalfa.

Salsify (Vegetable oyster).—Fertilizers same as for beets.

SORGHUM (For sugar).

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen.....	15 to 30	90 to 180 nitrate of soda; or 75 to 150 sulphate of ammonia; or 225 to 450 fish guano; or 3000 to 6000 stable manure.
Phosphoric acid.....	30 to 60	240 to 480 acid phosphate; or 75 to 150 double superphosphate; or 300 to 600 ground bone.
Potash	50 to 100	100 to 200 muriate of potash; or 100 to 200 sulphate of potash; or 400 to 800 kainite; or 1000 to 2000 wood ashes.

When grown for forage the application of nitrogen may be profitably increased. When grown for sugar the use of too much nitrogen is to be avoided.

Spinach.—Fertilizers same as for lettuce.

Spelt (Emmer).—Fertilizers same as for barley.

Squashes.—Fertilizers same as for cucumbers.

STRAWBERRIES.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen.....	25 to 50	150 to 300 nitrate of soda; or 125 to 250 sulphate of ammonia; or 375 to 750 fish guano; or 5000 to 10000 stable manure.
Phosphoric acid	50 to 100	400 to 800 acid phosphate; or 125 to 250 double superphosphate; or 500 to 1000 ground bone.
Potash	75 to 150	150 to 300 muriate of potash; or 150 to 300 sulphate of potash; or 600 to 1200 kainite; or 1500 to 3000 wood ashes.

Sugar Beets.—Fertilizers same as for beets.

SUNFLOWERS.

Relative proportions available plant-food.		Pounds material for one acre.	
	Pounds per acre.		
Nitrogen.....	15 to 30	90 to 180	nitrate of soda; or
		75 to 150	sulphate of ammonia; or
		225 to 450	fish guano; or
		3000 to 6000	stable manure.
		240 to 480	acid phosphate; or
Phosphoric acid.....	30 to 60	75 to 150	double superphosphate; or
		300 to 600	ground bone.
		50 to 100	muriate of potash; or
Potash.....	25 to 50	50 to 100	sulphate of potash; or
		200 to 400	kainite; or
		500 to 1000	wood ashes.

TOBACCO.

Relative proportions available plant-food.		Pounds material for one acre.	
	Pounds per acre.		
Nitrogen.....	100 to 200	400 to 1200	nitrate of soda; or
		500 to 1000	sulphate of ammonia; or
		1500 to 3000	fish guano; or
		20000 to 40000	stable manure.
		600 to 1200	acid phosphate; or
Phosphoric acid.....	75 to 150	180 to 360	double superphosphate; or
		750 to 1500	ground bone.
		300 to 600	sulphate of potash; or
Potash.....	150 to 300	3000 to 6000	wood ashes.

Avoid the use of such potash compounds as muriate of potash and kainite which contain chlorine. The sulphate of potash and also the carbonate which is contained in wood ashes are very desirable as sources of potash for the fertilization of tobacco soils.

TOMATOES.

Relative proportions available plant-food.		Pounds material for one acre.	
	Pounds per acre.		
Nitrogen.....	25 to 50	150 to 300	nitrate of soda; or
		125 to 250	sulphate of ammonia; or
		375 to 750	fish guano; or
		5000 to 10000	stable manure.
		400 to 800	acid phosphate; or
Phosphoric acid.....	50 to 100	125 to 250	double superphosphate; or
		500 to 1000	ground bone.
		250 to 400	muriate of potash; or
Potash.....	100 to 200	200 to 400	sulphate of potash; or
		800 to 1600	kainite; or
		2000 to 4000	wood ashes.

For early tomatoes, quick-acting forms of plant-food should be used. Many times it is best to apply the nitrate of soda in two or three partial applications.

For late tomatoes, slow-acting forms of plant-food may be used with good results.

Turnips.—Fertilizers same as for rape.

Vetch.—Fertilizers same as for beans.

Watermelons.—Fertilizers same as for cucumbers.

WHEAT.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen.....10 to 20	60 to 120 nitrate of soda; or 50 to 100 sulphate of ammonia; or 150 to 300 fish guano; or 2000 to 4000 stable manure.
Phosphoric acid.....20 to 40	160 to 320 acid phosphate; or 50 to 100 double superphosphate; or 200 to 400 ground bone.
Potash.....15 to 30	30 to 60 muriate of potash; or 30 to 60 sulphate of potash; or 120 to 240 kainite; or 300 to 600 wood ashes.

Do not apply large quantities of nitrate of soda in the fall as it will leach out of the soil and be lost, but apply most of it in the spring as a top dressing for the wheat.

FERTILIZER FOR GENERAL USE ABOUT THE YARD AND GARDEN.

Although there is no such thing as an all-round fertilizer which will give equally good results on all crops, nevertheless, it many times happens that we wish to use a little fertilizer or stimulant about some of the plants in the door yard or garden.

Light applications of wood ashes, never piled at the base, but spread broadcast about the plant and spaded into the soil are very beneficial, especially if they are followed by a light coating of chicken manure, or well decomposed stable manure. A desirable mixture of commercial fertilizers consists of

- 1 part nitrate of soda,
- 2 " fish guano,
- 6 " acid phosphate,
- 6 " ground bone,
- 3 " muriate of potash.

Apply this mixture at rate of 2 to 3 pounds for each 100 square feet and if convenient work into the soil. Applications every two or three weeks of smaller or larger amounts may be beneficial. Deep green, luxuriant foliage indicates plenty of nitrogen. Poor growth and yellow foliage indicates either lack of nitrogen or else a poor physical condition of the soil.

CAUTION.—Question the soil thoroughly as suggested on page six before adopting the wholesale use of fertilizers. Much money is unwisely spent in buying and using commercial fertilizers.

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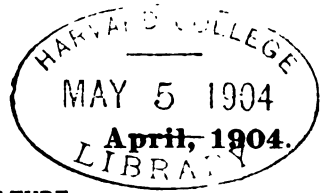
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Bulletin No. 80.

DEPARTMENT OF AGRICULTURE.

Oregon Agricultural Experiment Station.

CORVALLIS, OREGON.



Some Results in Swine Feeding.

By JAMES WITHYCOMBE.

**THE BULLETINS OF THIS STATION ARE SENT FREE TO ALL RESIDENTS
OF OREGON WHO REQUEST THEM.**

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SOME RESULTS IN SWINE FEEDING.

BY JAMES WITHYCOMBE.

This bulletin is presented, not for the purpose of demonstrating scientific principles in fattening swine, but rather with the view of giving to the practical farmer, in a popular form, the results secured from the different classes of grains and forage plants, found on the average farm, when fed to fattening and growing swine.

Fortunately the once popular idea that conditions in this state were not conducive to the development of swine husbandry to reasonable dimensions is now generally conceded to have been an error. Perhaps but few sections have better natural facilities for growing swine economically.

With the adaptability of practically the whole state for growing wheat, barley, peas and such valuable supplementary forage plants as alfalfa, the clovers, vetch, rape, there is little to be desired in addition for the production of a high class pork product at the minimum cost. It is a well established fact that hogs properly finished on these nitrogenous feeds supply the best quality of bacon and hams. The flesh of hogs fattened with such feed is rarely found to possess that undesirable softness so frequently met with in pork products from swine fattened on more highly carbonaceous food. In fact almost every desirable condition for the production of the highest type of bacon hog exists here.

Partial Immunity From Disease.—An important feature and one which offers substantial encouragement to the grower is the apparently slight danger of loss from disease. Maladies which are so baneful to the industry in many swine growing sections do not seem difficult to control here. This perhaps is largely due to dietetic influences, thus reducing the susceptibility to disease. The cereals and forage plants commonly grown on our farms are conducive to the maintenance of a healthy constitutional vigor in swine.

Expansion of Production.—It is strange why farmers do not give more attention to the production of swine. As already shown conditions are favorable, but perhaps hitherto the principal deterrent has been the unstability of the market. This should not impede

the expansion of the industry in the future, as our rapidly extending commercial relations, and increasing population should inspire confidence in the future strength of the market.

Consumption and Supply.—Statistics indicate that our farmers are not nearly supplying the local demand for pork products. It is estimated that 500,000 pounds of these commodities, representing a probable value of \$65,000, are received by Portland merchants monthly from outside points. It is obvious that this immense outflow of wealth for a product which nature has made it possible for us to produce economically here should be checked. There are approximately in this state at present, 326,000 hogs, which is considerably less than one hog per capita of our population. This indicates conclusively that the domestic supply will be inadequate to the local demand for some period of time.

The data supplied by this bulletin are the results of work extending through a period of several years.

EXPERIMENT A. To Determine the Value of Apples as a Swine Food.—

Three shoats about eight months old were confined in a pen with small open yard and fed all the apples they would consume.

FIRST PERIOD.		GAIN LBS.
Weight October 6th.....	408 pounds	
Weight October 20th.....	446.5 pounds	38.5
Apples consumed in 14 days, 897 pounds.		

SECOND PERIOD.		GAIN LBS.
Weight October 20th.....	446.5	
Weight November 4th.....	443.5	3
Apples consumed in 15 days, 1,119 pounds.		

It is apparent from this that apples are simply a maintenance food for swine. The good gain shown in the first period is evidently due to a fill-up, or perhaps to the influence of feed fed previous to the beginning of the experiment, as the hogs were not subjected to a preliminary preparation. Hogs cannot be expected to make a satisfactory growth upon apples alone as they contain but a small per cent of muscle forming material. However, if some nitrogenous supplementary feed were fed, doubtless the apples would have given better results. Where pigs are allowed the run of a clover or alfalfa pasture in connection with picking up the waste apples in the orchard, good results may be expected. In this case the alfalfa and clover would supply the protein thus making the ration much

more favorable for growth. The pigs kept in excellent condition throughout the experimental feeding, although during the last week they began to manifest symptoms of restlessness which were evidently expressions of hunger for a more nitrogenous diet.

EXPERIMENT B. Comparison Tests Between Ground Wheat, Barley and Barley and Potatoes.—Nine pigs of mixed breeding were used in this experiment, being divided into three lots as evenly as practicable. They were given one week of preliminary feeding.

FIRST PERIOD, 14 DAYS.

Lot	Weight	Food consumed, lbs.			Gain, lbs.	Average gain per period each pig, lbs.	Daily gain each pig, lbs.	Food consumed for one pound gain, lbs.
		Wheat	Barley	Potatoes				
1	Nov. 18 501	423			131	43.66	3.11	3.22
2	503		153	537	45	15	1.07	3.4
3	533		306		69	23	1.64	11.93
								4.43

SECOND PERIOD, 14 DAYS.

Lot	Weight	Food consumed, lbs.			Gain, lbs.	Average gain per period each pig, lbs.	Daily gain each pig, lbs.	Food consumed for one pound gain, lbs.
		Wheat	Barley	Potatoes				
1	Dec. 2 632	423			127	42.33	3.02	3.40
2	648		153	542	102	34	2.42	1.5
3	602		306		102	34	2.42	5.31
								3.0

THIRD PERIOD, 14 DAYS.

Lot	Weight	Food consumed, lbs.			Gain, lbs.	Average gain per period each pig, lbs.	Daily gain each pig, lbs.	Food consumed for one pound gain, lbs.
		Wheat	Barley	Potatoes				
1	759	426			75	25	1.78	5.68
2	750		237	550	91	30.33	2.16	2.60
3	704		474		74	24.66	1.76	6.04
								6.40

A small quantity of skim milk was fed occasionally, the supply being irregular, but when available it was equally divided between the three lots.

The barley was not a normal sample, weighing only 38 pounds per measured bushel.

PERCENTAGE OF GAIN.

Lot	First period	Second period	Third period
1	26.1	20	10
2	9	15.7	12.1
3	12.9	16.9	10.5

It will be noted that it required an average of 3.82 pounds of wheat to produce one pound gain in live weight; 4.43 pounds of barley, and of the barley and potatoes 2.28 pounds barley and 6.84 pounds of potatoes.



Lots 1 and 2 in Experiments D and E.

In this experiment 100 pounds of barley had a food value equal to 86.23 pounds of wheat and 100 pounds of cooked potatoes indicating a food value equal to 31.43 pounds of barley or 27.10 pounds of wheat.

EXPERIMENT C. To Determine the Relative Value of Wheat, Peas and Wheat, Cooked Potatoes and Wheat.—Six grade Chester White hogs were selected, representing two litters, three from each. These were divided into three lots, each lot containing one hog from each litter.

Lot	Weight at beginning of Exp. Pounds	Weight at close, pounds	Gain pounds
1.....	433	578	145
2.....	418	596	178
3 ^a	286	372	86

* One hog in lot 3 developed rheumatism shortly after the beginning of the experiment, hence was taken out.

Lot	Food consumed, pounds			Food for one pound gain, pounds		
	Wheat	Peas	Potatoes	Wheat	Peas	Potatoes
1.....	740			5.1		
2.....	600	300		3.37	1.69	
3.....	282		754	3.28		8.77

Thus it will be noted, in this instance, that when peas are fed in connection with wheat that 100 pounds of peas have a food value equal to 102 pounds of wheat. The experiment also shows by lot 3, containing one hog that 100 pounds of cooked potatoes have a food value equal to 21 pounds of wheat when fed as a supplement of wheat.

EXPERIMENT D. Boiled Clover Hay vs. Clover Silage as Supplementary Feed With Grain.—Six eight months pigs of the same litter were divided into two lots. Lot 1 was fed boiled second cutting clover hay and consumed of this during the period of 122 day's feeding, 619 pounds, representing 551 pounds dry substance. In addition the pigs of this lot received 488 pounds of wheat and barley chop.

Lot 2 was fed 2032 pounds of clover silage, containing 488 pounds of dry substance, with 488 pounds of the wheat and barley chop. Lot 1 gained 154.50 pounds live weight. Lot 2, 128 pounds.

Lot	Food required for one pound gain live weight, pounds.		
	Clover silage, dry substance	Boiled clover hay, dry substance	Grain
1.....		3.57	3 15
2.....	3.81		8.81

It will be noted that it required 21 per cent more grain to produce a pound gain in live weight when fed with the clover silage than it did when fed with boiled clover.

EXPERIMENT E. Cooked vs. Uncooked Grain.—The six hogs employed in Experiment D were put together and divided as evenly as practicable into two lots. Lot 1 was fed wheat and barley chop, cooked, while lot 2 was fed the same class and quantity of feed uncooked.

The feeding experiment continued for 90 days. Each lot consumed 1,834 pounds of the chop and 1,800 pounds of skim milk. Lot 1 gained in live weight 428 pounds. Lot 2, 470 pounds. The chop was fed dry to lot 2.

Observations were made during the experimental feeding as to the length of time consumed by the two lots in eating their meals. It was found that it took lot 2, 2.4 times longer to consume each meal than it did for lot 1.

Lot	Food consumed for one pound gain, pounds	
	Wheat and barley chop	Milk
1.....	4.28	4.20
2.....	3.90	8.88

Per cent gain in favor of uncooked grain, 9.8.

EXPERIMENT F. To Determine the Value of Clover Pasture for Growing Pigs.—May 2, 1900, 12 pigs about 3 months old were confined by means of hurdles on 26 square rods of good clover.

Weight of pigs, May 2, 563 pounds.

Weight of pigs, June 13, 723 pounds.

Weight of pigs, July 7, 755 pounds.

Weight of pigs, August 2, 816 pounds.

Total gain 253 pounds.

SUPPLEMENTARY FEED CONSUMED.

Shorts 317 lbs. @ \$11.00 per ton*	\$1.74
Whole milk 69 lbs. .90 per cwt.	.62
Skim milk 1,207 lbs. .15 per cwt.	1.81
	\$4.17
Credit by 253 lbs. gain @ 4½ cents per lb.	\$11.38
Net	\$7.21

Thus it seems that one acre of good clover for growing hogs, represents a value of \$44.36.



The Hog in Exp. J which made a gain of 184 lbs. in 70 days.

EXPERIMENT G. To Test the Value of Rape for Growing Swine.—August 20, 1900, ten pigs between four and five months old were turned on one acre of June sown rape. Weight of pigs, August 20, 693 pounds. Weight of pigs, October 1st, 847 pounds. Gain in live weight, 154 pounds. These pigs received no other feed during the time they were on the rape and they kept in a thriving and healthy condition during the whole period.

EXPERIMENT H. Wheat vs. Wheat and Peas for Young Hogs and Food Requirements for Fattening Mature as Against Immature Hogs.—Lot 1 and 2 each contained two eight months old hogs. Lot 3 consisted of three matured hogs. Lot 1 was fed a mixture of one-third peas and two-thirds wheat. Lots 2 and 3 were fed exclusively on wheat. The grain was ground and fed dry, but water was kept within reach of the hogs at all times.

* Commercial value at the time of the experiment.

FIRST PERIOD, 21 DAYS.

Lot	Weight lbs.	Food consumed		Wheat lbs.	Gain lbs.	Average gain per period each pig lbs.	Daily gain lbs.	Food for one lb. gain lbs.
		Wheat lbs.	Peas and wheat lbs.					
	Nov. 23, '01							
1.....	860		177		56 50	28 25	1.4	3.13
2.....	833	199.50			54	27	1.3	3.7
3.....	1035			498	63	21	1.0	7.90

SECOND PERIOD, 14 DAYS.

	Dec. 14							
1.....	416.50		189		44.50	22 25	1.6	4.24
2.....	387	210			51	25.50	1.82	4.12
3.....	1098			378	82	27 33	1.99	4.61

THIRD PERIOD, 14 DAYS.

	Dec. 28							
1.....	461		210		52	26	1.86	4.04
2.....	438	210			51	25.50	1.82	4.12
3.....	1180			420	95	31.66	2.26	4.42

FOURTH PERIOD, 14 DAYS.

	Jan. 11							
1.....	513		207		24	12	.86	8.62
2.....	489	210			40	20	1.43	5.25
3.....	1275			420	65	21.66	1.54	6.46

FIFTH PERIOD, 14 DAYS.

	Jan. 25							
1.....	537	139	67.50		20 50	10.25	.73	10.07
2.....	529	210			48 50	24.25	1.73	4.83
3.....	1340			420	82 50	27.50	1 96	5.09

Average amount of the peas and wheat mixture required in lot 1 to produce one pound gain in live weight during the whole period, 5.01 pounds. Average amount of wheat required for pound gain in lot 2, 4.25 pounds. For lot 3, 5.51 pounds. The young hogs in lot 2 made a gain for wheat consumed of 30 per cent over that made by the matured hogs in lot 3. Lot 1 did not seem to relish their feed during the latter portion of the feeding test, which apparently exerted an adverse influence upon their gain.

EXPERIMENT I. Crushed Wheat vs. Whole Wheat for Fattening Swine.—

Ten graded Berkshire-Poland China shoats averaging about eight months old were selected for this work and divided into two lots. These hogs were purchased from a local farmer and had apparently been stunted in growth, which perhaps partially accounts for the rather poor gains secured.

It will be noticed that for the first 31 days they consumed 5.12 pounds of wheat per day for each 100 pounds of their live weight. At the second period 5.19 pounds and third period 4.19 pounds.

FIRST PERIOD, 31 DAYS.

Lot	Weight pounds	Food consumed, lbs.		Gain pounds	Average gain per period each pig, lbs.	Daily gain pounds	Feed for one pound gain lbs
		Crushed wheat	Whole wheat				
	Oct. 15, '02						
1.....	470		736	190	38	1.22	3.87
2.....	480	772		210	42	1.32	3.68

SECOND PERIOD, 16 DAYS.

	Nov. 15						
1.....	660		560	125	25	1.56	4.48
2.....	690	560		130	26	1.62	4.30

THIRD PERIOD, 14 DAYS.

	Dec. 1						
1.....	780		471	75	15	1.07	6.28
2.....	820	471		68	13.6	.98	6.93

Average amount of whole grain required for one pound gain in live weight, 4.53 pounds. Average amount of crushed wheat required for one pound gain in live weight, 4.42 pounds. Per cent in favor of crushed wheat, 2.

EXPERIMENT J. To Illustrate Porcine Individuality.—A thrifty Ohio Improved Chester White barrow, farrowed, February 17, 1902, was placed in a pen alone. The feed of this animal during the summer consisted of skim milk, rape and vetch with very little grain.

Weight of pig at beginning of experimental feeding, November 1, 1902, 228 pounds. Weight at close of fattening period, January 10, 1903, 412 pounds. Consumed in 70 days, 586.50 pounds of crushed wheat and 280 pounds of skim milk, thus making a gain of one pound live weight from 3.19 pounds crushed wheat and 1.52 pounds of skim milk.

EXPERIMENT K. Silage and Apples as a Maintenance Food for Brood Sows.—Two young brood sows were placed in pen with open yard and were fed whole and cut clover silage, pea silage and apples at different periods.

FIRST PERIOD, 9 DAYS.

Weight, pounds	Food consumed, pounds			Apples pounds	Weight pounds	Gain pounds
	Whole clo- ver silage	Cut clover silage	Pea silage			
Aug. 5	625	176			Aug. 14 635	10

SECOND PERIOD, 35 DAYS.

Aug. 14	635		918		Sept. 19 650	15
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THIRD PERIOD, 12 DAYS.

Sept. 19	650			270	Oct. 1 655	5
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FOURTH PERIOD 79 DAYS.

Oct. 1	*910				5530	Dec. 18 996	86
--------	------	--	--	--	------	----------------	----

* Another brood sow added to lot.

The same sows were fed from December 19th to January 1st, 240 pounds of clover silage and from January 2d to 26th, 480 pounds clover silage; 72 pounds wheat chop and 144 pounds of skim milk. Weight January 26th, 1030 pounds, thus making a gain of 34 pounds. The result of this experiment shows that clover silage for matured hogs is slightly better than a maintenance ration. It also indicates that 64.3 pounds of apples will not only maintain a matured hog in good condition, but enable it to add one pound to its live weight. The experiment also indicates that a ration of one pound of crushed wheat, two pounds of skim milk and 6.66 pounds of clover silage fed to a brood sow weighing 300 pounds or over will keep her in good condition when not suckling pigs.

EXPERIMENT L. Wheat vs. Corn for Fattening Hogs.—Six five months old pigs were divided into two lots. Lot 1 was fed corn at the beginning of the experiment and later crushed wheat. Lot 2 was fed wholly on crushed wheat.

FIRST PERIOD, 15 DAYS.

Lot	Weight lbs.	Feed consumed, lbs.		Total gain for period lbs.	Average gain per pig, lbs.	Daily gain per pig, lbs.	Feed for one pound gain lbs
		Corn	Wheat				
1.....	Jan. 15, '08 310	172	.....	37	12.33	.82	4.65
2.....	340	.....	270	67	22.33	1.48	4.03

SECOND PERIOD, 14 DAYS.

1.....	Jan. 31 347	257.50	.....	40	13.33	.89	6.43
2.....	407	.....	274	80	26.66	1.90	3.42

THIRD PERIOD, 14 DAYS.

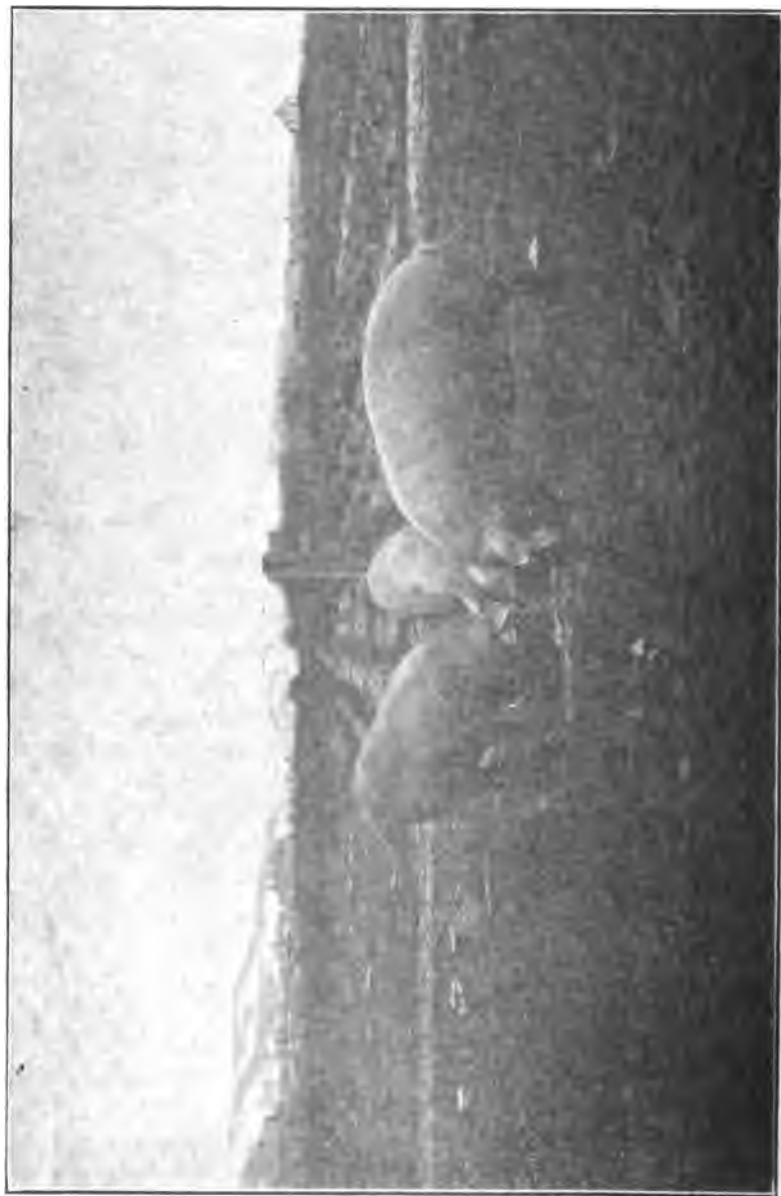
1.....	Feb. 14 387	212	82	38	12.66	.90	7.74
2.....	487	.....	310.50	53	17.66	1.26	5.85

FOURTH PERIOD, 14 DAYS.

1.....	Feb. 28 425	.....	240	50	16.66	1.19	4.80
2.....	540	.....	249	45	15.00	1.07	5.53

It will be noted that the average amount of corn required to produce a pound of gain in lot 1 for a period of 29 days was 5.58 pounds. Average amount of wheat for one pound gain required by lot 2 during the same period, 3.70 pounds. Percentage in favor of wheat, 51 per cent. Lot 1 did not take kindly to corn. The corn was fed whole during the first period of 15 days, afterward crushed corn was fed. They ate it, however, somewhat reluctantly during the whole time it was fed. During the last period of 14 days lot 1 was fed on crushed wheat. They enjoyed the change and showed their appreciation by eating their meals with considerable relish. They also made a more economical appropriation of the wheat consumed than lot 2, making a pound gain with 15 per cent less wheat.

EXPERIMENT M. Soiling Matured Hogs.—May 1, 1903, two freshly weaned sows were placed with two other matured hogs in a pen provided with a small open yard. The four weighed, May 1, 1325 pounds. They consumed in the first period of 31 days 845 pounds of rape, 880 pounds of crimson clover, 412 pounds alfalfa, 14 pounds of wheat screenings and 20 pounds of oats. June 1st, they weighed 1350 pounds. Thus they required 85.48 pounds of the green feed and 1.36 pounds of the grain mixture for each added pound of their live weight. From June 1st to July 1st, they consumed 1,642 pounds of alfalfa, and made a gain of 5 pounds. Hence they required 328.4 pounds of green alfalfa to produce one pound of live



Silage Fed Hogs in Experiment K.

weight. Better results would, undoubtedly, have been obtained, had the hogs been pastured on the alfalfa. By the latter method, they would have fed on the tender shoots, while in soiling, by the time the plant attained sufficient height to cut advantageously, too much woody substance was developed to suit the palate of the hog. Suffice it to say that the hogs maintained a good healthy condition during the whole time of the experiment.

EXPERIMENT N. Soiling Young Pigs.—May 1, 1903, sixteen pigs weighing 559 pounds were placed in a feeding pen with an open yard. From May 1st to June 2d, they consumed 1,693 pounds of crimson clover and alfalfa; 3,504 pounds of skim milk; 75 pounds of crushed wheat. Weight, June 2d, 780 pounds. Gain, 221 pounds. Thus requiring 15.85 pounds of skim milk, 7.66 pounds of the green fodder and .34 pounds of crushed wheat for one pound gain in live weight.

EXPERIMENT O. To Determine the Value of a Small Supplementary Grain Ration in Feeding Green Forage and Milk.—June 2d, the sixteen pigs used in Experiment N. were divided into two lots. Lot 1 weighed, June 2d, 375 pounds. This lot consumed from June 2d to July 1st, 502 pounds alfalfa, 2,308 pounds of skim milk. Weight, July 1st, 505 pounds. Gain, 130 pounds. Thus they required 17.75 pounds of skim milk and 3.86 pounds of alfalfa for one pound increase in live weight. Lot 2 weighed, June 2d, 405 pounds. This lot consumed from June 2d to July 1st, 2,055 pounds of skim milk, 456 pounds of alfalfa and 112 pounds of crushed wheat. Weight, July 1st, 530 pounds. Gain, 125 pounds. Thus they required 16.44 pounds of skim milk, 3.65 pounds of alfalfa and .90 pounds crushed wheat for one pound increase in live weight. The cost of producing a pound of live weight in lot 2 exceeded that of lot 1 by .55 cents per pound. There was apparently no advantage obtained in feeding the supplementary grain ration, except that lot 2 presented a slightly better external appearance than lot 1.

EXPERIMENT P. This Consisted of Feeding Finely Ground Wheat; Crushed Wheat; Whole Wheat; Crushed Wheat and Skim Milk to Fattening Swine.—Twenty shoats about six months old were divided as equally as practicable as to weight and sex into four lots, and were placed in comfortable pens, provided with two open yards, hence each lot was allowed the privilege of the open yard every other day.

FIRST PERIOD, 15 DAYS.

Lot	Food consumed, pounds					Gain for period lbs.	Aver. gain per pig lbs.	Daily gain per pig lbs.	Feed for one pound gain lbs.	
	Weight lbs.	Whole wheat	Crushd wheat	Finely ground wheat	Milk				Grain	Milk
Sep 1 '03										
1.....	525	335				95	19	1.27	3.53	
2.....	570		335			165	33	2.20	2.03	
3.....	555		270		255	80	16	1.07	3.37	3.19
4.....	565			335		110	22	1.47	3.05	

SECOND PERIOD, 15 DAYS.

Sept. 15										
1.....	625	462				100	20	1.33	4.62	
2.....	700		462			130	26	1.73	3.55	
3.....	685		417		270	140	28	1.87	3	1.92
4.....	690			462		125	25	1.67	3.70	

THIRD PERIOD, 15 DAYS.

Oct. 1										
1.....	715	552				90	18	1.20	6.13	
2.....	775		552			75	15	1.00	7.36	
3.....	795		504		270	100	20	1.33	5.04	2.7
4.....	795			552		105	21	1.40	5.26	

FOURTH PERIOD, 16 DAYS.

Oct. 16										
1.....	825	624				110	22	1.47	5.67	
2.....	905		624			130	26	1.73	4.8	
3.....	945		579		228	150	30	2.00	3.86	1.52
4.....	925			624		130	26	1.73	4.8	

FIFTH PERIOD, 14 DAYS.

Nov. 14										
1.....	915	588				90	18	1.29	6.53	
2.....	1030		588			125	25	1.79	4.71	
3.....	1060		546		252	115	23	1.64	4.75	2.19
4.....	1030			588		105	21	1.50	5.60	

It required an average of 5.28 pounds of whole wheat for one pound gain live weight in lot 1 and 4.10 pounds of crushed wheat in lot 2, thus indicating that crushed wheat is 28.8 per cent better than whole wheat for fattening hogs.

Lot 4 required an average of 4.45 pounds of finely ground wheat for one pound gain of live weight, which is 8.5 per cent greater than the amount of crushed wheat required by lot 2.

Lot 3 consumed an average of 3.96 pounds of crushed wheat and 2.18 pounds of skim milk for one pound gain in live weight. Thus indicating, in this instance, that 15.57 pounds of skim milk are equal in food value to one pound of crushed wheat. With wheat at 75 cents per bushel, this gives skim milk a value of 8 cents per 100.

EXPERIMENT Q. Pease and Barley as a Fattening Food for Mature and Immature Hogs.—Three pure bred Chester Whites were selected,

comprising a two year old sow and two eight months old shoats. They were fed a mixture of crushed peas and barley.

The experimental feeding was continued for 92 days, which is about 30 days longer than is usually advisable to feed for economical results. The fattening period was prolonged for the purpose of illustrating the increased cost of a pound of gain, when hogs were carried beyond what is generally accepted as a profitable stage.

FIRST PERIOD, 15 DAYS.

Lot	Weight lbs.	Food consumed, lbs.		Gain pounds	Average gain per period, lbs.	Daily gain per pig lbs.	Feed for one pound gain, lbs.
		Peas	Barley				
1.....	Dec. 1, '93 660	67.50	472.50	130	43.33	2.88	4.15

SECOND PERIOD, 15 DAYS.

1.....	Dec. 15 790	67.50	472.50	100	33.33	2.22	5.40
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THIRD PERIOD, 16 DAYS.

1.....	Dec. 31 890	75.25	526.75	100	33.33	2.08	6.02
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FOURTH PERIOD, 16 DAYS.

1.....	Jan. 15, '04 990	75.15	509.75	85	28.33	1.77	6.88
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FIFTH PERIOD, 15 DAYS.

1.....	Feb. 1 1075	71.75	502.25	82.50	10.88	.72	17.66
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SIXTH PERIOD, 15 DAYS.

1.....	Feb. 15 1107.50	67.50	472.50	27.50	9.16	.61	19.64
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Total amount of feed consumed, 3,380.90 pounds. Gain in live weight, 475 pounds. Thus requiring 7.1 pounds of grain for one pound gain in live weight.

It required for the first 46 days 5.1 pounds of grain for one pound gain, while it took 11.72 pounds of grain to accomplish the same result during the last 46 days. In other words it required 130 per cent more grain to produce a pound gain in live weight the last half of the whole period than it did in the first half. This indicates for best results, the fattening period should be shortened as much as practicable, or the hogs should be disposed of just as soon as they are in a proper condition for the market.

In all of the experiments the grain was fed dry, except the cooked feed in Experiment E. Each experiment was preceded by a

preliminary preparation, except in Experiment A. The hogs were fed regularly three times daily and were supplied with clear water twice a day. They were amply furnished with clean straw for bedding twice a week, at which time the pens were thoroughly cleaned. The experiments were carefully conducted, but under strictly practical conditions, hence equally as good results should be obtained under general farm conditions.

It is to be regretted that these experiments were conducted on



Hogs Fattened on Pease and Barley in Experiment Q.

such a restricted scale. This, however, was unavoidable owing to inadequate facilities for fattening larger numbers. With so few hogs in each experiment, results are liable to be influenced by the individuality of a single animal.

With but few exceptions no attempt has been made to give financial comparisons as to the cost of production between the different foods. The purpose of this bulletin is simply to state results obtained in fattening and maintaining swine with feed stuffs commonly found on the farm.

CONCLUSIONS.

In six feeding experiments with an aggregate of twenty-eight hogs of mixed breeding and various ages, the results show that it took 4.48 pounds of wheat to produce one pound gain in live weight. The results also show that for the first half of the fattening period it required but 3.81 pounds of wheat to produce one pound gain, while in the last half it took 5.12 pounds of wheat to produce one pound of gain; or, in other words, it required 34 per cent more wheat to produce one pound gain in live weight in the last half of the feeding experiment than it did in the first half. Thus indicating that the heavily larded hog resultant from a long period of feeding is much more costly to produce than the block hog, or the bacon type. In these experiments, wheat seems to have given the best results as a fattening food. Results also indicate that a bushel of wheat properly fed to reasonable well bred hogs, should produce approximately thirteen and one-half pounds of live pork.

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6000.

Bulletin No. 81.

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Department of Horticulture

OREGON AGRICULTURAL EXPERIMENT STATION

CORVALLIS, OREGON.



PYRUS RIVULARIS—OREGON CRAB APPLE.

THE APPLE IN OREGON

By E. R. LAKE

THE BULLETINS OF THIS STATION ARE SENT FREE TO ALL RESIDENTS
OF OREGON WHO REQUEST THEM.

S. A. Green
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THE APPLE IN OREGON

PART I

Topics Discussed.—Early History.—Earliest Varieties.—Later Plantings.—The Problem of Planting.—Site as to Soil.—Site as to Aspect.—Selection of Trees.—Planting.

This series contemplates four parts. Parts II, III and IV will deal with cultivation, pruning, harvesting, packing, storing, marketing, and manufacturing the inferior fruit into secondary products, and such other topics as naturally accompany the discussion.

INTRODUCTION

"An apple orchard is sure to bear you several crops besides the apple. There is the crop of sweet and tender reminiscences dating from childhood and spanning the seasons from May to October, and making the orchard a sort of outlying part of the household. You have played there as a child, mused there as a youth or lover, strolled there as a thoughtful sad-eyed man. Your father, perhaps, planted the trees, or reared them from the seed, and you yourself have formed and grafted them, and worked among them, till every separate tree has a peculiar history and meaning in your mind. Then there is the never failing crop of birds—robins, finches, king-birds, oreoles, red-birds, starlings and others, such a crop!"—*John Burroughs*.

EARLY HISTORY:

The history and development of apple culture in Oregon is unique. The story of the peculiar, almost romantic, conditions under which this fruit was introduced into the state by the pioneers; the eagerness with which the first settlers planted apple trees, and the fabulous prices for which the first fruit sold, sounds today more like a tale of the days of chivalry, than a sketch of times in Oregon fifty years ago. Though the story has been told over and over, it will be well worth reciting again in connection with this brief study of "the apple in Oregon."

In Iowa in the spring of 1847 Henderson Luelling planted a few score of yearling grafted apple trees in boxes along with other small trees of plum, cherry, pear, peach, and cuttings of grapes and bush fruits. In the early summer these boxes were lifted, placed in a wagon, and in due time—six months—reached Oregon. Throughout the long and hazardous journey, made with ox team, Mr. Luelling guarded with an ever increasing attachment these few hundred struggling plants, destined to be the basis of a great fruit industry in the new west.

The first orchard of grafted fruit in Oregon was planted that fall on a piece of freshly cleared land near Milwaukie. Thus began the orchard industry in Oregon. These trees and plants, brought across the plains at a measureless cost, in trials and hardships, to the owner, flourished in their new home; and in the years following returned—"a dollar a drop for the sweat I lost in getting the necessary water to keep them alive while we crossed the desert; and their luscious fruit repaid me many times over for the jeers, ridicule and contentions* of my comrades."

Mr. William Meek, a fellow traveller with Mr. Luelling, brought a sack of apple seed from the same region, and the following spring (1848) the two formed a partnership and established the first nursery in Oregon, alongside the first orchard of grafted fruit.

*It is said that in a few of the most difficult parts of the trail some of the party insisted upon throwing away the heavy boxes of trees in order to lighten the load. At such times only the evident disposition to fight, on the part of Mr. Luelling, saved them.

"It is related that the first big red apple produced by Oregon soil was borne upon a one year old root-graft in this early nursery in the fall of 1848, (?) and so great was the fame of it, and such the curiosity of the people, that men, women and children came from miles around to see it, and made a hard beaten track through the nursery to this joyous reminder of the old homestead so far away.

"The first orchards of notable size were planted in the Waldo hills, on French prairie and near Salem. The following varieties were the common ones of those early days: Red June, Summer Sweet, Red Astrachan, Gravenstein, Talman Sweet, Blue Pearmain, W. W. Pearmain, Gloria Mundi, Genet Baldwin, Rambo, Winesap, Jennetting, Seek-no-Further, Tulpahocken, American Pippin, Red Cheek Pippin, Rhode Island Greening, Virginia Greening, Little Romanite, Spitzenberg, Swaar, Waxen, and a spurious yellow Newtown Pippin, since called Green Newtown Pippin and generally considered worthless. Some few other varieties were probably introduced at the same time but of these there is no certain record.

"In 1850 Mr. Lewelling returned to the east and selected at the nursery of A. J. Downing, among other trees some Yellow Newtown Pippins, which were dug under the personal supervision of Mr. Downing. These trees were brought across the Isthmus. On fruiting these proved to be nothing more than the so-called Green Newtown Pippin of the first introduction, and the real Yellow Newtown Pippin as we have it now was not introduced until some years later.

"The first box of apples offered for sale in Portland by Mr. Lewelling was eagerly purchased at one dollar apiece, netting him seventy-five dollars. Following this, prices ranged from one dollar per pound to twenty-five dollars per box and retailed at as high as one and one half dollars per pound, and in one instance two dollars and fifty cents was paid for one apple.

"In 1853 the surplus, a few boxes securely bound with strap iron were shipped to San Francisco and sold for two dollars per pound.

"In 1854 the surplus amounted to five hundred bushels and was sold at a net price of one and one-half dollars to two dollars per pound.

"In 1855 six thousand bushels were shipped returning a net price of twenty dollars to thirty dollars per bushel.

"In 1856 shipments amounted to twenty thousand boxes. This year one box of Esopus Spitzenberg sold in San Francisco for sixty dollars net, and three boxes of Winesaps sold in Portland for one hundred and two dollars.

"From this time till 1869 the shipments during the fall and winter months varied from six to twelve thousand boxes per month. From 1870 shipments to California declined, as the young orchards of that state were coming into bearing at such a rate as to not only supply their own demand but to furnish some for exportation. In consequence of this loss of market, prices fell so low that thousands of bushels annually rotted beneath the trees, other thousands of bushels were consumed by stock. The enormous prices obtained during the fifties resulted in the planting of a great acreage of orchards. With the loss of the California market came a total collapse in the industry, since there were no adequate means of transporting the great yield of fruit from these young orchards to suitable markets."—*Dr. J. R. Cardwell, in First Oregon Report.*

Speaking of the abundance of fruit at that time E. L. Smith says:

"At a farm near Salem I purchased several hundred boxes of the largest Winesaps I had ever seen. I could have bought almost unlimited quantities of this fine fruit at from twelve and one-half to fifteen cents per bushel. In an orchard near Jefferson this fruit was still cheaper for there I remember seeing great Golden Belleflowers falling to the ground to the evident satisfaction of the pigs beneath the trees."—*E. L. Smith, at Farmers' Congress, Salem, 1902.*

The following note written in reply to a question asked Mr. Minto in February, 1902, throws an interesting ray of light upon the early orchards of Oregon:

SALEM, OREGON, February 14, 1902.

I should judge from my knowledge of the French Canadian settlers, that Joseph Gervais, who settled at Chemayway, was the first planter of apple trees in the Willamette Valley. He was the natural leader of his class, and in 1845 his orchard of apple trees looked to be twelve or fifteen years old at least. The Monteith brothers, Walter and Thomas, got water sprouts from Gervais' orchard which were the first planted at Albany, Linn county. Mr. Gervais used to seem proud to bring apples to Salem for sale at \$3 per bushel in 1849. I never saw nor heard of another French Canadian who had apple trees as old as his appeared nor that ever had apples to sell. Gervais came to Oregon with Mr. Hunt, Astor's partner, in 1811.

JOHN MINTO.

In reply to a request for an item from the "old orchard" for this bulletin the following was received from J. H. Lambert, a pioneer in Oregon orcharding:

PORTLAND, January 22, 1902.

The first trees were planted in the fall of 1847 and the varieties planted for the next few years were many; but, as the apple became an important item of commerce, the leading varieties for many years were the Yellow Newtown, Winesap and Baldwin. The Newtown was the highest priced but the Winesap was the most profitable being a most vigorous tree and a prolific bearer, and at that time, of good size, good quality and a fine, showy, red apple. The Baldwin was an early winter apple but the other two were good keepers and would ship well as late as May. I think there never has been any finer or more perfect apples raised than were grown in the Willamette Valley from 1854 until early in the seventies at which time the diseases and pests began to make their appearance and got in their destructive work. Young blood and new appliances may bring back the day of "Oregon's big, red apples."

Neglect of the crop and trees naturally followed this period of depressed prices. Soon the lichens began to give the trees the appearance of old age; lack of pruning was followed by close-matted and bushy tops, (See Fig. 1.); fences decayed, and stock took free use of the deserted orchard; in time, weeds, brush and trees of the native species sprang up and contended for the possession of the soil (See Fig. 4) and now one only too often sees seared, defenseless trees valiantly trying to maintain their broken files against the onrush of the aggressive fir. See Fig. 5.

LATER PLANTINGS.

The ebb of the apple crop in Western Oregon was during the eighties and early nineties. The decline had been rapid during the decade preceding 1890. With the loss of the California market, which was being supplied largely with the local product; the introduction of the codlin-moth; the appearance of scale and other fungous troubles; the premature breaking-down of many of the old



Fig. 1

orchards, due to lack of care in tillage and pruning, and to unsuitable sites, and the consequent decline in quality and appearance of fruit, the apple industry of Western Oregon which, only a few years previously had been the boasted pride of the Pacific Coast, winked-out, leaving a marvellous display of decrepit, moss-covered, fungus-ridden, worm-infested prematurely old apple trees, that should rightly have been in their prime (See Fig. 6). But though most of the pioneer orchards were things of the past it was not so with the impressions wrought by the luscious red and yellow apples

—their fruitage. The oft-repeated story of the “old-time-fruit” in the days when the “Oregon Big Red Apple” was famous, had its influence.

In the meantime men from the middle-west, with a knowledge of the commercial importance of this fruit, were investigating the possibilities of apple-culture on the coast. The sight of the orchard ruins of Western Oregon filled them with awe and forebodings. Almost to a man they were convinced of the evident unfitness of this great section for successful orcharding. Stunted, ill-shaped, scrawny trees appealed to them from every outlook; or, perchance,



Fig. 2

on some slightly knoll an hoary, lichen-splotched giant (Fig. 2), the very embodiment of ideals for future generations, might chance to meet their eyes, but its merits were of only passing moment, for all around were ruins, ruins, orchard ruins everywhere. And while these searchers after apple lands settled in eastern and southern Oregon, and have done much to bring these sections into high repute as fruit growing regions, the fame and profit of western Oregon apple orchards steadily waned. During this period of indifference and neglect many of the first orchards became so pest-

ridden and prematurely old that they were wholly abandoned. Some were entirely removed, while others were left to their own handicapped efforts in a fight against the ever-aggressive fir,* and destined to remain for years a picturesque feature of western Oregon landscape (See Figs. 4, 5, 6)—the horticultural ruins of an age of grain and stock raisers not yet extinct. For, it should be kept in mind that the Oregon orchardist of that day was generally a man whose conception of horticulture was incorporated in the phrase "seed time and harvest." On his calendar there was no season for cultivation; no period for pruning; and no time for



Fig. 3

thinning, and spraying was unknown. The crop was gathered or harvested in those days. Now we pick it. But this period of decline and abandon was fraught with a definite, though unseen purpose. It was the period of incubation of the germ of progressive present-day methods of apple-culture. Upon these ruins of the past we are today erecting some ideal orchard structures (See Fig. 11b). And while it is true that most of the newer plantings of apples are in small tracts there is a pronounced growing sentiment in favor of

**Pseudotsuga taxifolia*. Douglas spruce, Oregon pine, Red fir.

planting in larger, commercial areas. The recent success in marketing the crops of large orchards in both eastern and southern Oregon, has given an impulse to the consideration of the commercial aspects of apple-culture, such as we have not heretofore known. The early orchards of this section were planted near the homes, and as many of the pioneers selected the open prairie, much of which is level-lying land, for their homes, it came about that many of the orchards were planted upon heavy, poorly drained land, a condition which contributed much to the early decline in vigor and productiveness of these first orchards. Today the prospective orchardist, before planting, makes a full investigation of the various phases of the subject, especially as to the inter-relation of climate and soil; to the different varieties of trees; insect and fungous pests; inter-pollination; market demands; secondary products of the crop; economy of tillage and other manual operations as affected by the character of the site, and various minor features. As a result of this close attention to the requirements of the crop there are thousands of young apple trees being planted upon the better sites in the Willamette valley, once the boasted home of the big red apple. With the proper selection of varieties, skillful treatment of soil and tree, and constant warfare against the pests there would appear to be no reason why this section should not in a large measure regain its lost prestige in apple growing.

THE PROBLEM OF PLANTING.

Before the question of what to plant arises in the mind of the person about to engage in the growing of the apple there have come those other questions; shall I grow apples; if so, to what end; for home, local market, or shipment? And it is presumed that to these questions a final answer has been given. Whether this reply makes the one or the other object the purpose of the planting matters little, so far as the real work of planting and future care is concerned; though too often the plants upon which a crop is grown for home use are given little or no intelligent, appreciative attention.

There is no adequate excuse for the usual neglect of the trees, shrubs and vines that produce the fruits for home use. Only clean, healthy, vigorous trees may be expected to produce choice fruit and what tiller of the soil, would that his family should have fruit of an inferior quality (See Fig. 3). The plea that is usually offered in extenuation of the offense of an ill kept fruit-bearing plantation (see Fig. 11a) is that "we can't take time from the regular work to look after it." This is the merest absurdity. An essential part of man's duty to himself and family is to maintain good health. No single part of our usual diet does more to promote this condition than wholesome fruit. It is only with the best of health that the soil-tiller may expect to successfully compete with his fellow, hence, how important that he avoid, as far as possible, all demands upon the physician's services. For such demands mean a lessening of his earning capacity as well as an increase in financial expenses. Not alone this, for the growing of good fruit for home use gives a tone, keenness and enthusiasm to the family such as many times repays the outlay. The man, woman or child who works much out doors craves a good supply of fresh fruit, and such an one works harder and more cheerfully when liberally supplied with it. Reasons enough, certainly, why the fruit-garden about the home should be cultivated and the plants otherwise well treated.

And thus it should appear evident that there is really no essential difference between the problem of planting for home and that of planting for the market except, so far as relates to the varieties most desirable for the particular purpose in view.

Location.—From several points of view the problem of where to locate the apple orchard is one of considerable moment. Now that good, clean fruit, free from worms and fungi, is to be secured only at the expense of liberal and effective spraying it is important that the orchard be located so that this work may be done to the best advantage. Other conditions being equal one should locate near the home buildings and water supply. For the home orchard it will not be difficult to group the trees about the buildings in such a manner as to make them easily accessible for spraying, the most important, yet the most neglected part of the orchard's care, at present. But, for the commercial orchard the question of location assumes various other phases, such as the cost of land; access to shipping points; facility of tillage, depending upon character of soil and

climate; the inter-adaptability of climate and varieties, and the prevailing climatic conditions of the locality.

The usual standard varieties of apples do not begin to yield net results until about eight or ten years old if planted upon a soil of good body and suitable fertility. The cost of cultivating, pruning and spraying this growing crop for so long a period, added to the expense of first preparation and planting, together with the original cost of land makes a very formidable looking expense sheet; and when to this is added a fair allowance for interest on the investment it will be seen that the bringing of an apple orchard into bearing involves the expenditure of a no inconsiderable sum of money of which the original cost of the site may be an unduly large factor in the case of high priced land. Only when some particular advantages of soil, drainage, climate or suitability for desired varieties is to be gained may one feel free to look upon the first cost of land as an item of passing significance. Upon the inherent qualities of the location as above enumerated, and not upon the money value placed upon it, is the success of the orchard to rest. However, it is of little moment whether the land cost fifteen or forty dollars as against the successful growth of a crop of apple-trees. Still, it would be unwise to purchase at the higher price except some particular advantage to tree growth and fruitfulness appears evident. Every dollar used above the amount required to obtain a suitable site means the setting aside of so much "dead capital," a phase of the subject that must be kept well in mind throughout the whole consideration of orchard-building. While none but the thorough-going tree culturist—the man who loves trees and fruits for themselves—should engage in commercial orcharding, it is well enough that even he should have a clear conception at all times of cost and returns. Nothing so intensifies one's pleasure in labor, though it be a labor of love, as successful financial outcome. To have a hobby and that hobby a money-maker, is the acme of present-day incentives. And while nothing should be said that would in the least detract from the sentiment, love of nature, and broad ideals that should characterize our rural employments, yet our keenest appreciation usually comes from a knowledge of the value that others place upon the products of our labor.

Hence, select for a site as low priced land as is compatible with the desired requirements; deep, well-drained, moderately heavy, friable, fertile soil, in a locality where climatic conditions and

transportation facilities are favorable to the development of the crop.

SITE, AS TO SOIL.

Upon this very important phase of orchard-making all authorities are practically agreed. From the old orchards, and especially the old trees, of both Europe and America, the east and the west—the same lessons are learned. With one accord these trees, though separated by leagues of land and water, proclaim the creed of the apple tree—complete air and water drainage and a deep loamy soil.

Speaking upon this topic about two hundred years ago, Miller, an English authority, said:

"A gentle hazel loam, which is easy to work and does not retain the wet, is the best. Although these trees will grow on very strong land they are seldom so thriving, nor, is the fruit so well flavored as upon trees grown on a gentle soil. Dry sandy or gravelly soils are wholly unfit for the apple tree."

Delaville* writing upon the subject of soils suitable to fruit culture in France, says:

"A good soil for all fruit trees is composed of equal parts of sand, clay and lime."

Baltet,† a popular French horticultural writer in discussing the subject of soils desirable for the apple remarks that,

"A wheat soil is the soil for the apple tree when grown as a standard."

The importance of thorough drainage in connection with a good soil is emphasized by the same author in these words:

"The fruit of the apple is largest in the humid valleys, but best flavored on the hills and dry table-lands. The excess of humidity, as the need of free air, inducing canker and favoring the aphid."

Nanot‡ in his treatise upon the cider apple thus speaks of the soil as bearing upon this fruit:

"The apple is not very particular as to the nature of the soil; it neither dislikes very clayey, very limey nor very sandy soils—but the best flavored and longest keeping fruits come from trees grown on clay-loam."

Dr. L. H. Bailey,§ speaking of apple growing in the eastern United States, says:

*Cours Pratique D'Arboriculture Fruitiere, 1897.

†Traite de la Culture Fruitiere, 1900.

‡Le Culture du Pomme a Cidre, 1896.

§Field Notes on Apple Culture 1898.

"As a rule, rather light or loamy soils, with deep and porous subsoils, are best adapted to apple growing. Natural drainage is imperative. Apple trees are impatient of wet feet."

At a meeting of the Oregon State Horticultural Society, held in Newberg in 1901, E. L. Smith made the following statements while speaking briefly of the apple:

"Apples grown on sandy soil will weigh much less per bushel than those grown on clay or clayish soils, other conditions being equal. Apples to be long keepers must be grown on soil having some clay."

In reply to a question relative to this point Col. G. B. Brackett, the pomologist of the U. S. D. A., writes (1904): "I know of no experiments along this line, but I am inclined to think that apples grown upon clay loam, other conditions being equal, would be somewhat heavier than those grown upon light sandy soil. I know that apples that are grown on heavy clay soil are apt to keep better than those grown upon light, sandy, porous soil. Of course keeping qualities depend somewhat upon latitude and also upon the elevation at which they are grown."

From somewhat extended general observations in the apple orchards of western Oregon during the past decade or more, I am convinced that much of our soil is admirably suited to the apple tree. The land upon which the Douglas Fir thrives when not too steep and rocky is usually well adapted to the culture of this fruit. The alluvial soils of the minor valleys when of a depth of eight to twelve feet or more produce thrifty, vigorous, long-lived trees. Some of the best old orchards in the state are located upon the gentle rolling lower hill lands of Yamhill county, while some of the cleanest and thriftiest of the younger generation orchards are to be found on the red hill lands of Polk and Marion counties. In the selection of a site on the higher elevations or even upon the lower hill lands, care must be exercised to the end that shallow soils may be avoided. Streaks, patches or larger areas of these lands are occasionally underlaid at a depth of a few feet by strata of impervious rock. Such sites are wholly unfit for orchards. Only a close and thoughtful inspection of hill land tracts will enable one to avoid setting trees on soil too shallow for the successful growth of long lived and fruitful trees.

Many excellent small orchards are to be found upon the river bottom lands in all parts of the Willamette Valley. While these latter sites are well suited to the growth of the apple tree it is prob-

able that better returns, horticulturally, may be obtained by the cultivation, upon such sites, of the smaller fruits and the choicer vegetables, especially when near-by markets are reasonably good. The latter crops cannot be grown upon the higher lands with the same degree of success as attend their culture upon the river-bottoms, while with the apple there is no apparent difference save, perhaps, in the degree of earliness with which the trees begin to bear profitable crops.

Generally speaking, orchards upon bottom lands will begin to bear from one to three years later than those upon the higher lands. There are well known instances in which trees planted upon river-bottom land as a result of an abundance of water have extended their vegetative period three to four years beyond the normal period for the same varieties when grown upon correspondingly good up-land sites. The economics of horticulture would appear to point toward the up-lands as affording the more promising sites for the apple orchard, since the value of such lands will not increase as fast as that of the more restricted tracts of suitable river-bottom soils.

During recent years a trouble that has caused much uneasiness among orchardists in timbered sections is the appearance of a fungus that causes the loss of many trees. Usually death results after the tree has reached bearing age. The foe attacks the tree under cover of the soil and no indications of its presence appears until it has such a firm hold upon the tree that its loss cannot be prevented. Timbered land is generally infested with several so-called toadstool fungi, which live upon the native tree growth. The forms that infest the native oak and possibly other trees, when deprived of their host plants through the clearing of the land, have the power of adapting themselves to other trees, as those of our common orchard fruits. These fungous plants appear to be able to live in the soil for some length of time after the host trees have been removed, even to the stump. If young trees are set out on such land they are liable to attack and if attacked there is, so far as present knowledge goes, no hope for the tree. It will live a few years, varying with the vigor of the fungus, but throughout this time it leads a precarious life making little if any returns to the cultivator.

Until the life history of these plants is better known and some preventive against their ravages has been discovered, new land should be avoided in the setting out of an orchard. Land that has

been under croppage less than five years, especially if previously timbered with oak should be deemed unfit, or at least distrusted, for orchard planting, except a previous examination showed the absence of these tree-inhabiting fungi upon the native timber.

Drainage.—Having settled the matter of soil the next important point is the drainage of the site. If possible, by all means select a site that is naturally well drained. It should be so drained that both an excess of water and cold air can readily escape to a lower level. While the apple very much dislikes a wet, soggy soil, it equally dislikes a site upon which cold air may stagnate. Cold air seeks the lowest levels. It frequently carries with it the frost waves that kill blossoms in the spring, or immature wood in the autumn. The force of this point is readily impressed upon the minds of all those who drive over the gently undulating sections of our valley after nightfall in the spring or early autumn months. Every hollow, especially if it be one without a pronounced outlet to lower levels, fills up with cold air and as one passes from the crest to the bottom and up the opposite side the change from the cold air of the bottom to the warmer strata above is as distinctly marked as the passing from a warm room to the open air on a frosty morning. Such places, hollows or pockets, into which cold air may settle and remain with little or no motion, are death traps not alone for the apple but for fruit trees in general. Though the soils in such places may be good and deep and water drainage of the best, yet is the site deficient in one of the most important elemental features of a site—air drainage. It is as imperative to keep still cold air away from the tree's head as it is to keep stagnant water away from its feet.

For the home orchard it may be impracticable to plant upon an ideal site, so far as water drainage is concerned. In such an event means for artificial drainage may be employed. Tiling easily ranks first for this purpose and if laid at a depth of four to five and one-half feet and twenty to forty feet apart corresponding with the distance apart of the rows, a measurably good system of drainage may be provided; but, it cannot be expected to take the place of natural drainage; for, it is quite impracticable to put the tile twelve or more feet deep to which depth it is desirable that the roots may have access without being subject to standing water.

SITE, AS TO ASPECT.

"Aspect is sometimes important if the locality is liable to late frosts, a northern aspect is to be preferred as the trees will start later on such a site; if there is no danger from late frosts, as near large bodies of water, then a southern aspect is probably the best as it gives a higher color and finer flavored fruit."—*Bailey, Field Notes on Apple Culture, 1893.*

"The apple as cultivated in the open air is found in all exposures, yet those of the south are not expedient in cold or dry situations. A northern exposure for certain non-colored varieties gives a good product, notably with Canada Reinette. For the varieties which must be colored a sunny exposure, east, south or west is to be preferred."—*Passy, Arboriculture Fruitiere.*

"A gentle eastern or northeastern slope, as a rule is the most desirable for an apple orchard site, but this may vary with the section."—*Brackett.*

"Perhaps the very best aspect on the whole is a gentle slope to the south-west, because in such positions the trees when in blossom are somewhat protected from the bad effects of a morning sun after spring frosts. But, to remedy this more perfectly it is sometimes the practice to plant on the north side of hills, and this is an effectual way where early frosts are fatal, and where the season is long and warm enough to ripen the fruit in any exposure.

"Deep valleys with small streams of water are the worst situations for fruit trees, as the cold air settles in these valleys on calm frosty nights, and buds and blossoms are frequently destroyed. On the other hand the borders of large rivers or inland lakes are the most favorable, as the climate is rendered milder by large bodies of water. And then the slight fog rising from the water in the morning softens the rays of the sun, thus gradually dissolving the frost and preventing the damage that might otherwise occur from sudden thawing."—*Downing, Fruit Trees of America, 1888.*

"The warmer exposure of a southern slope may, and often does, favor the premature swelling of the buds and starting of the sap during mild, pleasant and bright early spring weather and vegetation is often seriously injured from this cause. Some planters, however, prefer a southern slope, thinking that the fullest exposure to the sun is essential; others select a northern aspect, in the hope that they may there avoid a too early excitation of vegetable life, and also that the heats of summer may be thus moderated. In my own opinion, the aspect is a matter of little consequence to the success of an orchard, though my predilections are in favor of an easterly exposure. The dangers of a southern aspect in summer, and the advantage of a northern slope, may, in a great degree, be obviated or obtained by judicious planting and pruning. In many parts of the country it is much more important to consider the exposure with reference to the prevailing winds of the region, and to select the site and aspect that will insure protection."—*Warder, American Pomology. 1867.* See Figs. 9a and 9b.

"The aspect of a fruit plantation exerts great influence upon the temperature of the soil and upon the force of the winds, and it therefore becomes an emphatic problem in the location of an orchard. There is a great diversity of opinion respecting the proper exposure for fruits, some growers contending that the northward slope is always the best, and others preferring a southward exposure. The truth is that no one exposure is best in all cases. Much de-

pend upon the location and the particular environment of the plantation. In locations adjoining bodies of water, the best slope is toward the water; in interior and frosty regions the best slope would be a north or west one if not so pronounced as to retard the autumn growth; if one desires early or high colored fruit, a warm, sunny exposure, to the southward or southeastward would be best."—*Bailey, Principles of Fruit Growing 1897.*

The diversity of geological formation and exposure in the apple-growing districts of Oregon render this topic of aspect a peculiarly interesting one. In some sections little attention aside from that given to heavy winds is necessary; in other sections the southern exposures, while desirable in many respects, are liable to have a thin soil underlaid by impervious rock; in still other sections the northern slopes, ideal in several features, have a soil rich, deep, full of humus, very moist, and thus prone to keep the tree growing too late in the season, and unduly retard the bursting of the buds in the spring; and in yet other sections the aspect is quite a matter of indifference, as in the Rogue and Grande Ronde river valleys proper. But, upon the bench lands of these sections, when more attention is given to the planting of orchards upon them, due attention to aspect will be of no little importance, and may be a deciding factor between success and failure with particular varieties. Especially in Rogue river valley would it appear that the later keeping varieties will demand the cooler northern exposures while the earlier varieties will do best upon the southern and eastern slopes.

In the Willamette valley, except in the districts tributary to the "gaps" in the coast mountains through which strong sea breezes issue, a southern aspect would seem generally desirable, providing it is not on a hillside with thin soil. The general low altitude of the valley, together with the average high humidity, makes an open or southern aspect desirable, since under such conditions fruit will tend to take on a higher color, an item of considerable importance in the commercial part of the crop. For early or mid-season varieties, however, and particularly those for home use, where one attaches more importance to fine specimens with clear skins, mellow flesh, and juiciness and where several days or a week's time in the date of ripening does not detract from the value of the product, a northern, western or sheltered aspect may be of first choice.

While high color is usually a feature of much commercial value in the apple, those who have formed a discriminating taste and grow fruit for their own use give it but passing notice. Thus it is

that the aspect most desirable for the commercial orchard may be of but secondary importance to the home orchardist.

As much of the autumn weather in western Oregon is of low light value, owing to the humidity, it is necessary to use considerable discretion when selecting a site for the growing of a commercial apple crop of the late keeping varieties, if one would have a high colored product one year with another. Judicious wood pruning and thinning of fruit will materially aid in enabling the fruit to get the most advantage from the light available.

SELECTION OF TREES AND PLANTING.

The proper selection and planting of trees is an important part in the starting of an orchard.

Tree Ideals Faulty.—At the outset it may be said that our general ideas of the character of a first-class tree for planting are quite faulty. Each variety of fruit tree is more or less characteristic in its form of growth—"habit" as it is often termed, and it is fortunate that this is so, else what a monotonous appearance our orchard plantations would assume. To this fact, that each variety possesses a characteristic habit, we should give more than passing attention when selecting trees for a new orchard. For, in order to obtain first-class trees for planting, and, none other should be used, the orchardist must have a knowledge of the "points" of a good tree of the variety under consideration. Some trees while in the nursery assume an erect, strict habit with an even regular taper; others are kinky, irregular in the direction of ascent and having an uneven taper; and still others are short, thick and inclined to branch. Yet, notwithstanding this wide divergence of character, these trees may all be first-class. The character or habit of the variety must be fully studied and then trees possessing a strong inclination to follow the type habit should be selected. Oftentimes no better source of information on these points can be found than the nurseryman. It is his business to study trees. If the market sets, as it often does, in its misguided demand, a general uniform require-

ment for all trees, then the nurseryman is obliged to meet it, and the attempt is made to grow all varieties to a common type, or else discard those varieties that do not form a "pretty tree" of gross vigor regardless of important merit. When the planters learn that the trees of no two varieties have the same habit; in fact, that no two trees are alike, then may we expect to find nurserymen growing trees for their real merits and not for looks. It may be a real merit for a tree to be straight, slender and gradually tapering, or it may be a merit for it to be kinky, thick and with little taper. It all depends upon the variety. If you have not well defined ideas of the requirements of first-class trees then take counsel of a reliable local nurseryman of some years standing if such an one is to be found in your locality. If not, then deal with the established firm that is nearest you and one that would be connected naturally with your locality commercially. Under such circumstances it is generally safe to rely upon the dealer to send you first-class trees of the varieties ordered, for his business reputation rests upon the service he performs. In this age, when the market value of an object depends so largely upon looks; and, when our ideas or tastes in this direction are the result of faulty education, it is little wonder that our ideas of what looks good may be quite out of harmony with the real merits of the object under consideration.

Age of Trees to Plant.—Formerly, and even at present in some parts of the east, writers advise the prospective orchardist to purchase two-year-old, or even three-year-old trees for transplanting. But such advice is rarely if ever given in Oregon at the present time. Trees one year old are old enough. The younger a tree is when removed from the nursery the less of its active root system is left there. The least check is given to a plant when it can be transferred with root and stem systems intact. It is quite impracticable to remove a grafted or budded tree from the nursery without more or less injury to its root system. The younger the tree is, however, the less will be this injury, and consequently the less the check in its development as a result of removal. As the tree gets older larger wounds are made upon the roots as they are severed, and these wounds offer a place for attack by fungi, and often prove the source of much trouble to the future tree. When the young tree is removed from the nursery row relatively small roots are severed, the wounds,

if properly treated, soon heal and danger from fungous foes is reduced thereby to a minimum.

One-year-old apple trees often grow to be five feet, and more, tall, and five-eighths of an inch and more thick, on Oregon nursery land. It is rarely if ever that we find yearling apple trees less than three feet in height. There is no reason for asking for larger trees for transplanting.

How to Plant.—The trees selected, next comes the planting. If possible the roots should be carefully pruned immediately upon removal from the nursery row. This can only be done when the nursery is near by and the buyer can be on the ground at the time removal is being made. Trees should remain out of the soil only so long as is necessary to transfer them to the packing or heeling-in grounds. If one can get the trees at the nursery when lifting operations are in progress, he can remove all bruised and broken roots; make clean and smooth all ends where roots have been cut or broken off by the lifting implements; cover the trees with moist cloths, straw or hay and convey to the site for planting with as little delay as may be, at all times using great care not to expose the roots to drying winds or frosts while out of the ground. Upon getting the trees at place of planting, or the home, heal them in at once. If the trees have been transported by rail or boat see that all broken roots are removed and that fresh, clean, smooth cuts replace broken, bruised or roughly made end wounds before they are heeled-in.

Heeling-In.—Dig a trench on the north side of a building, in the shade of a grove or on the north slope of a hill. Make the north side quite steep; give the other side an easy slope; place the trees upon the sloping side, one, two or three deep, with their neatly trimmed roots close up to the steep side or face of the trench, then cover them over with fine soil to the depth of a few, or several inches, depending upon whether or not they are to endure freezing weather while heeled-in. This treatment first of all keeps the air from the roots, keeps them moist and enables the wounds to "callus" a process necessary to the perfect healing of the wounds and the early and vigorous production of new rootlets. When once the trees are rooted, pruned and heeled-in they are in the best condition for awaiting the time for the next step—planting.

THE TIME TO PLANT.

In western Oregon fall planting is to be advised. The soil tiller has less rush-work at this time; the soil is usually in good workable condition; trees set out in the fall get fully settled into place before growing weather opens the following spring; and, usually a tree planted in the fall will have begun to put out little roots before the soil is in fit condition for work in the spring. These conditions all tend toward more favorable results from the work of transplanting.

The following quotation from a letter written by Karl J. Stalkland shows how the best orchardists of eastern Oregon view this matter:

"I know of only one objection to fall planting for this section and that is, that owing to heavy falls of snow some of the trees might be broken down. This occasionally occurs in this region, once in ten years perhaps. I consider fall planting advisable for this section because, if the land is not prepared and the trees set out in the fall our cold, wet springs will so delay the work, often to the extent of a month, that at least a third of the first season's growth will be lost. Except for accidents which might result in the death of a few trees, as through the failure to keep stock out of the newly set orchard, everything is to be gained by fall planting.

Good advice would be to recommend that the site be well prepared in the fall and that trees be planted at the earliest possible moment in the spring. Such a course, if followed, and the work done well and with dispatch would result nine times out of ten in satisfactory growth and the possibility of loss from freezing out, breakage from heavy snow, and injury by loose stock would be avoided. The chief difficulty with early spring planting is that it is quite impracticable to get the wet unmanageable soil in close contact with the roots of the newly set tree. The usual disposition among young planters is to wait till the spring planting fever tingles in the nerves. When this course is followed he invariably loses heavily on the first year's growth and this greatly affects the subsequent development of the tree."

Distance to Plant.—Austen, writing upon this topic over two hundred years ago, says:

"He should choose to prescribe the planting of these trees fourteen to sixteen yards asunder; for both trees and fruits have many great advantages if planted a good distance one from another. The sun refreshes every tree, the roots, body, and branches, with the blossoms and fruits; whereby the trees bring forth more fruit, and those fairer and better. When trees are planted at a large distance, much profit may be made of the ground under and about these trees by cultivating garden-stuff and small fruits. When trees have room to spread they will grow very large and great and the consequences of that will be, not only multitudes of fruits, but also long-lasting, and these two are no small advantages. Men are mistaken when they say, the more trees in an orchard the more fruit; for one or two large trees which have room to spread will often bear more fruits than six or ten of those that grow near together and crowd one another. Let men but observe some apple trees that grow a great distance from other trees and have room enough to spread both their roots and branches, and they shall see that one of those trees, having come to full growth, hath a larger head, more boughs and branches, than four, six or more of those which grow crowded near together, though of the same age."

Most of the local nurserymen advise planting the apple from thirty to forty feet apart. Though formerly, when the large old orchards were planted the usual distance was sixteen and one-half feet. In more recent years twenty to twenty-four feet has been the more common practice. Recently some of the larger growers like the Olwell brothers are taking the position that the trees in an apple orchard should be planted at least thirty-six feet apart each way on the heavier soils. For the first few years this seems like a useless waste of land. But if the soil is such as an apple orchard ought to be put upon, it will not be long before it will be apparent that to successfully operate the implements of tillage, spraying and harvesting, the trees, at thirty-six feet apart are close enough. Yet, notwithstanding this position of many of the larger orchardists, as well as the eastern authorities some of our most successful orchardists take exception to these distances. Karl Stackland, a most successful grower of the apple, says: "An area will yield about so much good fruit, and it matters little whether the trees are twenty or forty feet apart, so far as the ultimate yield is concerned."

The force of the positions taken upon this point depends primarily upon the character of the soil and varieties grown. Early apples and the varieties of rather dwarf stature do not need as much room as those of more vigorous habit, or later maturity. Then again, trees grown on a deep, heavy moist, soil, where the season of growth is long, need much more room than when grown upon light, shallow, dry soil, if it is permissible to put the apple upon such soils as the latter. But using these terms only in a comparative manner, which might be done when discussing the soils of the river bottom lands of the Willamette Valley and the foot hill lands of

portions of southern and eastern Oregon where some most excellent apples are grown, the position is still one that holds good in all sections equally well, for not all apples of western Oregon are grown on bottom lands nor are all apples grown in southern Oregon and eastern Oregon grown on bench lands.

Generally speaking the bottom lands of any section are deeper and moister than the hills or table lands of the same section, but they are not always heavier as is particularly exemplified along the narrower river valleys where the so-called "bars" are nearly always composed of light drift or sedimentary soils. However, the moisture retaining power of these soils is equal to or greater than that of the more clayey upland soils. The presence of moisture is the significant factor. From the evidence that can be adduced from the apple growing sections of the state it is very plain that trees of the same variety will often make twice the growth in some localities that they do in others, though the size and appearance of the fruit may be identical, with this difference, that the fruit on the dwarf trees is earlier and consequently higher colored. Trees of Northern Spy and Baldwin are often found upon the lower or heavier soils of the Willamette Valley that never yield a fruit with highly colored cheeks, except in very unusual, bright, warm autumns. In fact, if it were not for these unusual seasons one would be tempted to question the title of the variety. And yet, there are trees of these varieties grown on the nearby hills which always produce fruit of high color, thus showing that the trees on the heavier soil cannot mature their fruit without a longer season, and this, due in a large part, to the fact that the tree devotes more time to vegetative functioning. Other conditions being equal dwarf growing trees, shortage in water supply, lightness of soil, and closeness of trees tend to induce early fruitfulness and maturity. But, in the presence of ample water and deep, fertile soil, trees may grow so vigorously as to cause branches to interlap thus rendering the tops a matted, bushy mass of fruitless wood, much of which must be removed before the trees begin to bear, and in many instances some of the trees themselves must be taken out before space sufficient for ripening a good crop of well colored fruit can be had. Such conditions cause much loss in both time and labor, and the trees thus grown yield an inferior product, all of which may be avoided by planting the trees at such a distance as will allow ample space for full growth and the formation of an open head with free access to light and air.

For standards this would be not less than thirty-six feet on good soil and forty feet would probably be better. On lighter or shallower soils the distance apart might be reduced to thirty or thirty-two feet.

Double Planting.—In order to bring all of the soil of the orchard into early service some of our best orchardists, especially in eastern Oregon, recommend the planting of two or more types of trees at the time of setting out the orchard, for example: If the orchard is to be composed of standard varieties, set at forty feet apart, half way between the trees each way should be set trees of some early bearing varieties, as plums, cherries, summer and autumn apples and early pears.

As the standard trees begin to bear these "fillers" as they are commonly termed, may be removed. The advantages claimed for this mode of planting is that the standards are protected by the fillers, which come to maturity earlier, and a crop is produced from the soil thus helping to pay the expenses of tillage for the period during which the standards are growing wood. Others of our leading orchardists contend that better results follow the growing of herbaceous crops as potatoes, beets, tomatoes and even corn. The tendency of most people to leave trees, when planted as fillers, until they encroach upon the space and food supply of the regular plantation leads one to accept the latter view as being the better for the average planter to follow. There is a greater probability that annual crops would be discontinued before their culture would in any way detract from the care and food supply required by the permanent plantation.

Some of the thriftiest, cleanest, best-cared-for small young orchards in this state are to be found at May Park, a suburb of La Grande. Figs. 7a, 7b, 8a and 8b show the character of the secondary crops grown in this section—corn, tomatoes, potatoes, melons, beets, carrots, strawberries and others of the like. There are no cases of double planting with these later orchards, though some of the earlier plantations at a nearby orchard section were put out upon this plan. In this district thirty feet is considered ample space for an apple tree. As grown here the tree is headed low (See Fig. 15), branches are shortened in; the growing season is one of normal length, or even a little short, and the resting period somewhat severe; hence the vegetative vigor of the tree is some-

what reduced, and thus the trees of the varieties grown find quite space enough in thirty feet.

Plan of Planting.—There are two general styles of orchard plantings: the hexagonal and the square. Fig. 12 represents a plat planted on the hexagonal plan. The rows are twenty-eight and

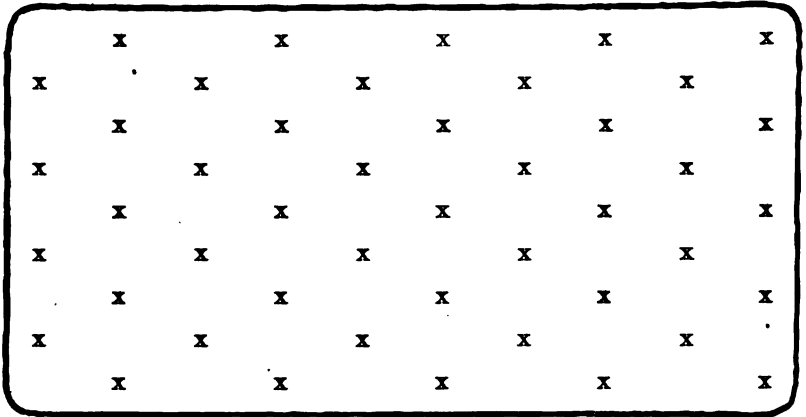


Fig. 12. 52 trees, 33 feet apart.

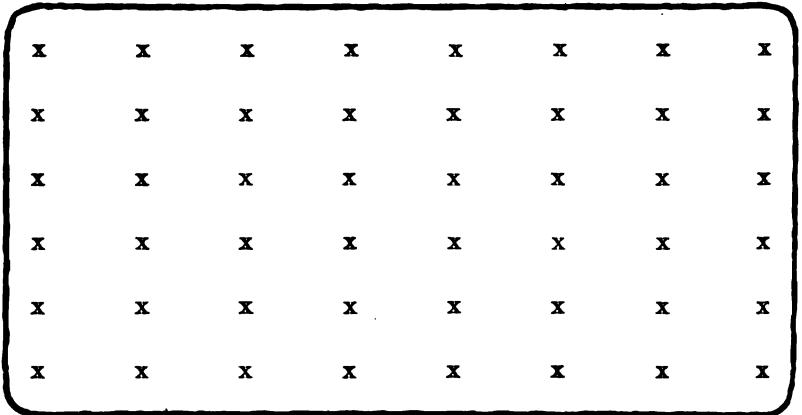


Fig. 13. 49 trees, 32 feet apart.

one-half feet apart three ways, while the trees are thirty-three feet apart. Fig. 13 represents a plat planted on the square plan. The rows are thirty-two feet apart at right angles. Even at the closer

distance in this latter plan there are less trees to the acre. With rows farther apart there would be about the same relative difference between the numbers of trees per acre on the separate plans.

In the former style each tree is equally distant from the six adjacent trees surrounding it, or, in other words, all adjacent trees are equally distant; while in the latter style, each tree is equally distant from only four adjacent trees. Thus, it will be seen that by adapting the hexagonal plan the land space is more economically used; the trees are more evenly distributed over the land.

To lay out a piece of land on the square plan it is necessary to establish two base lines at right angles, which may be done by sighting along the long and short arms of an ordinary carpenter's square, set upon three stakes driven at the corner of the proposed plantation, and setting two rows of stakes in lines continued from the arms. Put the stakes as far apart as the rows are to be and when the stakes have been set, in lines at right angle to each other, to the limit of the piece of land to be planted, move the square to the corner diagonally opposite the first used and run lines of stakes along the other two sides of the piece. Then by using a few long stakes two men can "line-in" the stakes for the body of the plantation. The outside rows of trees ought to be at least one rod inside of the fence line. If carefully done this sight staking is as good as a surveyor's work for orchard purposes.

If the plan adopted is the hexagonal, then a somewhat more different course is to be followed in the first part. Establish one base line for the first row of trees. Let this row be from one rod to twenty feet from the fence line. See Figs. 10a-10b. Firmly drive small one inch square stakes where each tree of this row is to be set. Procure a wire, No. 10 or 12 is about right weight, make a fixed loop in both ends so that the distance between the extreme ends of the loops is one inch more than the distance at which the trees are to be planted. Then let A put one loop over stake one; let B put a stake through the other loop, step off toward the center of the field; when the wire is taut, he shall describe a short arc in the earth with the point of the stake. Let A then step to stake two, row one, over which he places the the loop in his end of the wire; when the wire is again drawn taut another short arc is made. Where the two arcs intercept a stake should be driven for the first tree in row two. While A remains at stake two, row one, B passes to a point at which he estimates the next stake for row two should

be placed, another short arc is described, and A passes to stake three, row one. A second intercepting arc is made and B places stake two of row two and so on till the row is complete. From this point other stakes may be sighted in as the two base rows will afford a good foundation. If the site is rolling the stakes of these first two rows ought to be four to six feet long.

After the plat is well staked it is ready for planting and herein probably lies the most difficult part for the beginner, as he too often finds it impracticable to get the trees planted in as good lines as the stakes were. A little device for keeping the tree exactly in the place occupied by the stake is illustrated in Fig. 14. When about

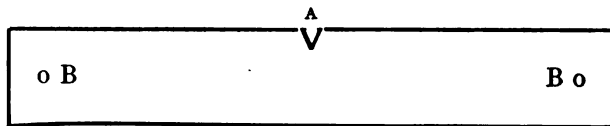


Fig. 14

to plant a tree place the notch A over the stake which has been set in place for a tree, then drive a stake through each of the holes B B, in this way the guide is fastened in such position that the notch is over the spot in which a tree is to be set. Now remove the guide leaving the three stakes in position. Pull out the center stake, dig the hole for the tree, place the guide in position with holes B B over the two outside stakes; put the tree in position so that it occupies the notch A. Cover the roots with earth, firmly pressing it with the feet. When the hole is filled, and the tree sets firmly, remove the guide, pull up the two end stakes and repeat with next tree. If the work is carefully done the trees should line up as well as the stakes did. Trees having irregular trunks, must be so set that the general line of growth will be in position. If there is a likelihood of strong wind prevailing from a definite quarter during the first few years growth of the trees they should be so planted as to lean firmly in the direction of the wind.

The trees should be so set that when the soil about them fully

settles they will still be in the ground as deeply, or better, two or three inches deeper than before removal from the nursery.

The hole into which the young tree is transplanted should be made large enough so that all roots may assume a fully extended and spreading position. No roots should be placed in a curled or twisted position. The center of the hole should be higher than the margin. This will allow the roots to assume a natural position, slightly downward and outward. The earth that is placed immediately in contact with the roots should be finely pulverized and pressed down firmly. For this purpose the feet may be effectively used, care being exercised that no injury is done the roots by tramping directly upon them. When the hole is about half filled no further pressure is needed, and the soil may be thrown in loosely, finishing by heaping it up about the trunk five or six inches above the general surface.

In sections where more or less frost accompanies the winter season fall-planted trees may be rendered good service by the addition of a coarse mulch to the surface of the soil, but under no conditions allow the mulch to surround the trees closely, otherwise rodents may infest it and "bark" the tree. If it is spread upon the ground and then a small mound of earth, as before stated, surrounds the tree, thus preventing the mulch material from coming in contact with it, damage from the small gnawing animals may be fully prevented.

LIST OF BULLETINS

(In print) published by the Oregon Agricultural Experiment Station to July, 1904.

Circular No. 1—Dairying in Oregon	Shaw, French and Kent
No. 6, 1890—Chemistry, Zoölogy	Washburn
No. 7, 1890—Small Fruits and Vegetables	Coote
No. 8, 1891—Varieties of Wheat and Flax	French
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No. 28, 1894—Pig Feeding, continued	French
No. 29, 1894—Horticulture, Pruning, etc.	Coote
No. 30, 1894—Potatoes and Roots, continued ..	French
No. 32, 1894—Five Farmers' Foes	Craig
No. 33, 1894—Tent Caterpillar	Washburn
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No. 37, 1895—Experiments in Cattle Feeding ..	French
No. 38, 1895—Fruit Pests	Washburn
No. 39, 1895—Grasses, Chemistry	Shaw
No. 40, 1896—Prunes, Apples and Pears	Hedrick
No. 42, 1896—Feeding Sheaf Wheat	French
No. 43, 1897—Flax Culture	French
No. 44, 1897—Review of Oregon Sugar Beets ..	Shaw
No. 47, 1897—Cheat and Clover	Shaw and French
No. 50, 1898—The Fertility of Oregon Soils ..	Shaw
No. 51, 1898—Marketing Fruit	Craig
No. 52, 1898—Nut Culture	Coote
No. 58, 1898—Sugar Beets	Shaw
No. 54, 1898—Flax, Hemp, Dairy, etc.	French and Kent
No. 55, 1898—Chemistry of Cherries	Shaw
No. 57, 1899—Brown Rot	Cordley
No. 58, 1899—Rose Culture in Oregon	Coote
No. 59, 1899—Sugar Beet Experiments of 1898 ..	Shaw
No. 60, 1900—Apple Tree Anthracnose	Cordley
No. 61, 1900—The Oregon Prune	Shaw
No. 62, 1900—Miscellaneous Investigations ..	Shaw
No. 63, 1900—Prevention of Smut on Oats—Preliminary Bulletin	Pernot
No. 64, 1901—Investigation of Diseases in Poultry	Pernot
Circular Bulletin concerning Acid Soils in Oregon—1900	Knisely
No. 65, 1901—Creameries and Cheese Factories of Western Oregon	Kent
No. 66, 1901—The Grape in Oregon	Lake
No. 68, 1902—Birds of Oregon	Woodcock
No. 70, 1902—Testing Milk and Cream	Kent
No. 71, 1902—Stagnant Water Germs in Milk ..	Pernot
No. 74, 1903—The Cultivation of Vegetables and Notes on Varieties	Coote
No. 75, 1903—Insecticides and Fungicides	Cordley
No. 76, 1903—Leguminous Forage Plants	Withycombe
No. 77, 1903—Continuation of Bulletin No. 74 on Onions, Strawberries, Vegetables	Coote
No. 78, 1904—Canning Cheese	Pernot
No. 79, 1904—Plant-Food and Use of Fertilizers	Knisely
No. 80, 1904—Some Results in Swine Feeding ..	Withycombe

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Fig. 4

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Fig. 4



Fig. 15



Fig. 6



Fig. 7 a



Fig. 7 b



Fig. 8 a



Fig. 8 b



Fig. 11 a



Fig. 11 b

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Bulletin No. 82.

November, 1904.

Department of Horticulture

Oregon Agricultural Experiment Station.

CORVALLIS, OREGON.



Fruit of Pyrus rivularis
OREGON NATIVE CRAB.

THE APPLE IN OREGON.

By E. R. LAKE

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THE APPLE IN OREGON

PART II

Topics Discussed.—Varieties for Home Use.—Pollination.—Tillage.—Cover Crops.—Pruning.

This series contemplates four parts. Part I dealt with Early History.—Earliest Varieties.—Later Plantings.—The Problem of Planting.—Site as to Soil.—Site as to Aspect.—Selection of Trees.—Planting. Parts III and IV will deal with varieties for commercial planting, harvesting, packing, storing, marketing, and manufacturing the inferior fruit into secondary products, and such other topics as naturally accompany the discussion.

VARIETIES.

"If a child be in a fair garden about St. James tide he will choose a sweeting, because it is presently fair and pleasant, and refuse a rennet, because it is then green, hard and sour; when the one, if it be eaten, doth breed both worms and ill humors; the other, if it stand his time, be ordered and kept as it should, is wholesome of itself and helpeth to the good digestion of other meats. Sweetings will receive worms, rot, and die on the tree, and never or seldom come to the gathering for good and lasting store."—ROGER ASCHAM, in the Schoolmaster.

The question, what varieties shall I plant, is one that faces every beginner in orchard work, and is one that can be answered as fully by himself as by any other person. In the first place none but himself knows fully his own likes and dislikes, which, for a successful orchardist, must be as pronounced as for one in any other line of work. The man who does not possess a strong personal equation in favor of some varieties is quite likely doomed to disappointment in the cultivation of the apple, as in other fields of industry. Coupled with this personal factor favoring certain varieties must be a full consideration of the fitness of the variety to the soil and climatic conditions of the site in view. In all but the newest sections of the country this information of suitability of varieties may be obtained from local growers, except possibly, when some new variety is under consideration, and such an one is hardly what should be planted to any considerable extent until after full local trial.

Though it is quite impossible to have fresh apples of good quality the year round without recourse to the cellar, store-house or cold-storage room, yet it is practicable, through judicious plantings and such care in storage as every home of average means is able to provide, to have fresh fruit of the apple seven or eight months of each year. On a basis of a family of five and for an average western Oregon farm home the following list was suggested in 1901 for the purpose of enlisting discussion and comment: Two trees Transparent; one, Oldenburg; two, Gravenstein; one, King; one, Spitzenburg; one, Grimes Golden; one, York Imperial; one, Baldwin or Spy; one, Waxen; one, Hyslop (crab).

The following comments were made by our leading growers in the various districts of the state:

"List all right, quantity and quality, except put two trees of Jonathan in place of one King and one Transparent. Jonathan is vastly better than King anywhere, at any time."—W. K. NEWELL, Washington Co.

"Can suggest no improvement upon the list submitted for the home orchard.—R. H. WEBER, Wasco Co.

"I should select the following for the above purpose: One tree each of Red Astrachan, Gravenstein, King, N. Spy, Baldwin, Roxbury Russet, Waxen, Y. N. Pippin, Hyslop."—F. A. SLEIGHT, Clackamas Co.

"My list for this purpose would be: One tree each of (Y) Transparent, Oldenburg, Gravenstein, Dutch Mignonne, King, Grimes Golden (Pippin), Waxen, Baldwin, (E) Spitzenburg.—J. H. SETTLEMIER, Marion Co.

"One tree Red Astrachan; one Oldenburg; three, Gravenstein; one, Rhode Island Greening; one, Spitzenburg; three, Baldwin or Spy; two, Waxen; one Rambo—the Rambo is good eating—one, Hyslop."—THOMAS PAULSON, Washington Co.

"I would suggest for this part of the valley a Swaar or (Red-Cheek Pippin) Monmouth Pippin in place of Spitzenburg as both of these do well here and are late keepers, but the Spitzenburg does not thrive here.—L. T. REYNOLDS, Marion Co.

"We think the following list would not make the orchard too large: One tree each of Red Astrachan, Maidens Blush, Bismarck, and two trees each of Jonathan and Stark, and where they do well, two trees of Y. N. Pippin."—ALBERT BROWNELL, Linn Co.

"One tree of Transparent is enough. I think N. Spy too shy to depend on. The Gravenstein is all right. In place of the second Transparent of the list I should put one Winesap or (Red-Cheek Pippin) Monmouth Pippin for a long keeper."—J. J. VAN KLEEK, Washington Co.

"For this region our J. H. Stewart suggests the following list for the home orchard: One tree of Red Astrachan; one, Oldenburg; one, Maidens Blush; one, Gravenstein; two, Jonathan; one, Swaar; one, Spitzenburg; two, Yellow Newtown; two, Bennett."—S. L. BENNETT, Jackson Co.

"The list submitted is good. I should add one tree of Seek-no-Further, and one, Fall Beauty. This latter I consider better than Waxen. It is an excellent table apple and fine for cooking. A Yellow Newtown ought to be added for those sections suited to its growth."—S. D. EVANS, Douglas Co.

"We think your list as complete as it is possible to make one in covering so large a territory. For this locality we should plant no Spitzenburg as it is a poor tree here. We should add one tree of Maidens Blush. This tree thrives here, bears regularly, and we regard it as a very fine cooking apple."—F. B. CHASE, Lane Co.

"I think half the number of well fed trees would be sufficient. I have one Gravenstein and no family of ten can use the yield. I would reject the Waxen, also the Baldwin because it has too many dark spots inside—(spot-rot) (dead-spot) (dry-rot). I know nothing of the Transparent, Oldenburg, Grimes Golden or York Imperial.—JOHN HENRY, Washington Co.

"I think the list a good one but would select Jonathan in place of Spitzenburg and also think the Wealthy should be included as it comes between Gravenstein and King; or possibly I should drop the King and put Wealthy in its place, if I thought the list too long. Our soil is particularly adapted to Baldwin, Jonathan and Northern Spy."—ASA HOLADAY, Columbia Co.

"I suggest the substitution of one tree of (Red-Cheek Pippin) Monmouth Pippin for one Transparent because of the excellence of the fruit, and one tree of Ben Davis in place of one Gravenstein for use in late spring, and one tree

of Winesap in place of Spitzenburg. Winesaps were a favorite in childhood and we cling to them from "blessed memory."—L. M. GILBERT, Marion Co.

"I should amend the list to read: One tree of Transparent; one, Oldenburg; one, Waxen; two, Gravenstein; two, Spitzenburg; two, Yellow Newtown. I should not attempt to grow either the King or Baldwin in this locality as both varieties are subject to bitter rot. The Yellow Newtown is a late keeper of best quality, both for cooking and dessert."—A. H. CARSON, Josephine Co.

"For a family orchard I should plant as follows: One tree, Transparent; one, Hawley (superior to Transparent); two, Gravenstein; one, King; one, Spitzenburg; one, Grimes Golden; one, York Imperial; one, Baldwin; one, Rhode Island Greening; one, Bailey Sweet; one, Transcendent. I consider the quantity rather small for a family of five, until the trees reach quite an age."—JUDD GEER, Union Co.

"For the home orchard I should substitute the Early Goodwin for the Transparent. I believe the Early Goodwin the best apple on earth for this season. I should plant Rome Beauty instead of York Imperial. Transcendent should take the place of Hyslop, as it is altogether better. Then I should add the Jonathan to the list and from my point of view the selection would be excellent."—G. A. HOBBS, Umatilla Co.

"For our locality we should amend the list to read as follows: Two trees of Yellow Transparent; one, Oldenburg; one, King; two, Gravenstein; one, Jonathan; one, Grimes Golden; one, York Imperial; one, Winesap; one, Rome Beauty; one, Spokane Beauty; one, Transcendent (crab). Spitzenburg, Baldwin, Northern Spy and Hyslop do not thrive in this locality. Spokane Beauty is the best all-round family apple for cooking that I know."—S. A. MILLER, Umatilla Co.

"For an Hood River home orchard I should name this as a list: One tree of Red Astrachan; two, Transparent; two, Gravenstein; two, Jonathan; two, Baldwin; two, Wagener or Ortley; two, Spitzenburg; two, Yellow Newtown; one, Whitney or Transcendent. King, water-cores badly; York Imperial lacks quality of taste; Whitney is the largest crab. I believe it is well to plant two trees of each variety as one is liable to injury and premature decay."—E. L. SMITH, Wasco Co.

"I should advise for home use one tree of Transparent; one, Gravenstein; one, King; one, Delicious; one, Ortley; one, Lady; one, Hyslop; two, Spitzenburg; two, Yellow Newtown. I know this list would suit my desires and this locality better than the one submitted. The Waxen is too sour and non-marketable, should one chance to have more than could be used at home. I should want plenty of Spitzenburg and Yellow Newtown. I should plant no tree to dig up in future; too much labor lost."—A. I. MASON, Wasco Co.

"It is difficult to improve the list submitted for general home purposes, but for our use we prefer the following: One tree of Transparent; two of Gravenstein, for early use; two, King, very fine for fall use; two, Waxen, best for cooking and sauce and everybody likes it; two, Baldwin, old reliable; one, Spitzenburg and one, Northern Spy, or one, Yellow Newtown, for winter keeping; one, of a long keeper like American Pippin, could be substituted for one Baldwin or King. Some people do not care for crabs and so I leave them off my list."—GEORGE ARMSTRONG, Benton Co.

"Referring to your list for a family orchard I wish to say that I do not know the Transparent. The Spitzenburg is not a healthy tree with us. The King, Ben Davis (Gloria Mundi) Monstrous Pippin, Twenty Ounce and some others I do not consider family fruits, as they are grown more for show and display than for use. As you know, much depends upon soil, climate and soil moist-

ure and I name the following varieties as they do well with us, the trees being particularly healthy and vigorous. One tree each of Red June, Rambo, Gravenstein, Waxen, Transcendent (crab), and two each of Baldwin and N. Spy."—CHAUNCY BALL, Multnomah Co.

"For my own use I should want a sweet apple in the list but I do not know of one that is fully satisfactory. I should also wish a very late keeper, even if I had to take Ben Davis or some other of that type. I think I should prefer a large number of trees to start with, for it takes so long for them to come into full bearing. It would be an easy matter to grub out a few of the most undesirable ones if fruit became too plentiful. My list would be about as follows: Your list plus one more each of King and Baldwin, the late keeper and sweet one as noted above. As the Spitzenburg does not thrive well in this section I should be disposed to leave it out of the list."—DR. A. MILLS, Yamhill Co.

"Our list for the home would be: One tree of Early Harvest; one, Astrachan; two, Gravenstein; one, Waxen; one, King; one, Grimes Golden; one, Rhode Island Greening; one, Baldwin; one, Spitzenburg; one, Northern Spy; one, Yellow Newtown; one, Hyslop (crab). An Early Harvest and an Astrachan gives a longer season for very early fruit than the list submitted. I am not acquainted with Oldenburg or York Imperial, but the Swaar is a great favorite of mine and I should plant a tree of this variety. The Yellow Newtown is added for those soils and locations that are suited to its growth. It is a leader among apples but its growth is slow and bearing shy in this section."—G. W. RIDDLE, Douglas Co.

"For city conditions and limited space I should choose: One tree of Yellow Transparent; one, Gravenstein; one, Wealthy (superior to Oldenburg and better keeper); one, King; one, Yellow Belleflower (in place of Waxen or Spy); one, Grimes Golden; one, York Imperial; one, White Pearmain (a general favorite here, and a reliable bearer); one, Jonathan (never should be left out, too rich and prolific for that); one, Spitzenburg; one, Stayman (much superior to Baldwin for late winter). To make twelve trees, same as list given, should select one tree Fameuse or Carolina Red June, also a small limb of Transcendent (crab), if my good neighbors had none, as a whole tree will furnish enough fruit for a dozen families."—KARL STACKLAND, Union Co.

"I would suggest the following list for the purpose you name; I am familiar with these. Others may be as good but I don't know them to be. Two trees each of Early Harvest, Gravenstein, King, Yellow Belleflower, four trees N. Spy and one of Hyslop. Should this amount of trees yield too much in time, I should not remove any Gravensteins for if there be too much fresh fruit it makes a most excellent evaporated product. I find to my sorrow that the Spitzenburg is dry and pithy when grown in this valley. For baking there is no apple in the world equal to the Yellow Belleflower, and—

"Such dumplings as mother used to make
All out of Yellow Belleflowers."

For a long keeper one needs nothing better than the N. Spy. It keeps until April or May."—CHARLIE LONG, Marion Co.

If ample site is at command it may be well to plant two or even three trees of each variety and when they have grown to be of considerable size remove the undesirable or unnecessary ones. During the first eight or ten years the fruit of three or four trees of a variety would be none too much for home use, but with the development of the trees two, or even one, would yield all a family of five or six would need or use. In such case it is better to remove the extra

trees than to endanger the health and vigor of the trees, and the quality of fruit upon the remaining ones, as is only too frequently the result under such circumstances. An excess of fruit tends to cheapness, this induces an indifference which sooner or later disastrously affects the care and attention that should be given the trees every year. When once neglected it requires double the effort to renew the care formerly given. This is often "the straw that sets awry" and down goes an orchard that otherwise might have been a pride and a joy to its owner, an untold blessing to the family and a boon to "the stranger that has tarried within thy gates."

POLLINATION.

During recent years no one phase of orcharding has received more thought than that of pollination. Though more or less regarded by the leading horticulturists of the past, at least since Knight's time, this subject rose to one of paramount importance upon the publication of a bulletin upon the pollination of the pear, by M. B. Waite in 1893. Since the appearance of this bulletin many observations have been made upon this very important subject and all have tended to prove the importance of it. Today no intelligent orchardist contemplates planting varieties until he has fully investigated their self-sterility or self-fertility, and their fitness for cross-fertilization. However, it must not be understood that all failures of crop can be ascribed to the impotency of pollen. Nor that the pollen of relatively shy-bearers like the Spitzenburg or Northern Spy is altogether impotent for it is known that in many instances the pollen of such varieties is efficient as a fertilizer.

Then again, local climatic, soil, seasonal or other conditions may be such that the pollen of some individuals or varieties may be impotent one season, while fully effective the following or subsequent years. This fact is particularly evidenced in the conduct, one season with another, of the Italian prune. Large blocks of this fruit are to be found in various parts of Western Oregon and Western Washington in particular. Some years it bears a fairly full crop in all sections; in other years the orchards in one or more localities will fail, or produce but a partial crop, while orchards in other parts bear full crops; and even individual orchards in a locality may bear a full crop, or none, while others are returning opposite results.*

* There appears to be accumulating evidence tending toward this conclusion rather than that slight frosts or rains are fully responsible for the failures of the Italian to set fruit some years.

From the researches of Waite and others there is reason to believe that the same general rules relating to the impotency of pollen will apply equally well to the apple, pear, plum and cherry, though perhaps less noticeable with this latter fruit, as large blocks of single varieties are not as common as with the others.

In summarizing the results of this work upon the apple and the pear Waite says: "Too much importance must not be attached to cross-pollination as a factor in fruitfulness. There are other factors equally as important. The variety, vigor, health, age, heredity and vitality of the tree; the presence of undue climatic, soil and site conditions and fungous diseases, are all vital factors in the fruitfulness of orchards and must not be overlooked." *

Varieties generally considered self-fertile, that is, safe to plant alone are: Ben Davis, Rome Beauty, Jonathan, Baldwin †, Fallawater, Oldenburg, Rhode Island Greening, Astrachan.

Varieties that are considered more or less self-sterile are: Spitzenburg, Northern Spy, Gravenstein, Winesap, Belleflower, Willow-Twig.

The above list is only tentative at best. Investigators are a unit in declaring that, other conditions being favorable, nearly all varieties are more or less improved by cross-fertilization, hence a liberal mixing of varieties in a plantation is to be recommended; provided, they are capable of inter-pollination. For it must not be forgotten that not only are varieties self-sterile but that they are also cross-sterile. Until much more information is obtained in detail as to the conduct of particular varieties under the varied conditions to which they are subject, implicit confidence cannot be placed upon the reputed behavior of other than a few of the varieties most widely grown as Ben Davis, Winesap, Jonathan, Rome Beauty.

In view of this condition a point of much interest to the apple grower is the relative periods of blossoming of the inter-pollinating varieties. For with a knowledge of this at hand there may be planted side by side such varieties as will interpollinate and blossom during the same period thus effecting cross-fertilization and thereby doing away with the troublesome question of sterility and at the same time deriving the best possible results as to size and quality of the crop at a possible minimum of loss. If the planta-

* Waite, M. B., U. S. Agr'l Report 1898.

† Trees of this variety have been observed to be apparently self-sterile. See report quoted above.

tion is of such size that three or four varieties may be grown to advantage, so far as marketing the crop is concerned, then the problem becomes one of getting such first-class varieties as will succeed on the proposed site, inter-pollinate, and blossom at the same period. If it is not possible to get first-class inter-pollinating varieties that will blossom at the same time it may be possible to get an inferior variety at slight disadvantage, as to marketable value, that will pollinate the better varieties. Under such conditions the insuring of a crop of the best grade fruit of two or three choice varieties at an expense of one inferior variety would be considered a judicious procedure. In view of this condition as to the relative blossoming periods of varieties and as to whether or not they will inter-pollinate or cross-fertilize, the work done at the Delaware station affords some interesting data.

Investigations made in 1900 indicated that Stayman, Paragon, York Imperial and Missouri Pippin are self-sterile varieties. That Stayman and Paragon will not inter-pollinate; that Stayman can be fertilized by Missouri Pippin or York Imperial; and that Missouri Pippin and York Imperial will inter-pollinate.

In 1901 the same station made investigations upon a larger scale. The following varieties, located in three different orchards were observed: Astrachan, Sweet Bough, Early Harvest, Early Ripe, English Russet, Fanny, Gilpin, Gravenstein, Grimes, Fourth of July, Lilly of Kent, Missouri Pippin, Nero, Paragon, Red Streak, Stark, Stayman, Strawberry, Williams Favorite, Winesap, Yellow Transparent.

Only two varieties of this list proved to be fully self-fertile, Sweet Bough and Fourth of July, and these are of no practical commercial value. It was noted also that of this list the early varieties were the more self-fertile. Only one winter variety, Gilpin, was at all self-fertile. Where duplicate trees of the same variety were observed it was noted that there was a difference of degree of self-fertility between the individuals. In conclusion the author notes: "It is essential that varieties blossom together if they are to be planted for inter-pollination. Apples are more stable in their blossoming habits than other fruits, especially plums. The length of the blossoming period of a given variety may vary with the season and with the care of the trees. The treatment of the soil has a considerable effect upon the blossoming period, for example: Light soil devoid of humus and lacking in tillage shortens the blossoming

period. Good tillage, plenty of humus and fertilizing material in the soil prolong the blossoming period. Spraying to preserve the foliage is also a factor in lengthening this period. It appears that the blossoming period is apparently very largely governed—other conditions being favorable—by the length of the flower-forming period of the previous summer and fall.”*

For several years a record of the College orchard has been kept with this point in view, namely, to ascertain what varieties blossom at the same period. The following tables give the results in substance. One observation, however, needs to be made at this point. Records kept at other places, both within and without the state show that the periods of blossoming of certain varieties do not remain invariable. In other words, two or more varieties that blossom at approximately the same period at Corvallis, may not blossom together at Hood River and La Grande, or at Medford and Cove.

For example: In the table on page 16 it will be observed that during the season of 1903 at Hood River—

Early Harvest and Red Astrachan were in full blossom on May 1st.

Jonathan, Spitzenberg, Ben Davis and Baldwin were in full blossom on May 8th.

Yellow Newtown, May 10th; Northern Spy, May 12th.

On examination of the table on page 16 it is noted that at Cove—

Early Harvest and Red Astrachan were in full blossom on May 5th and 7th respectively.

Jonathan, Spitzenberg, Ben Davis and Baldwin were in full blossom on May 20th, 25th, 20th, 16th, respectively.

Yellow Newtown, May 25th and Northern Spy, May 20th.

The same season the records at Corvallis show that the Early Harvest tree under observation did not blossom; that Red Astrachan was in full blossom April 28th; Jonathan, May 1st; (Spitzenberg, no tree old enough to blossom in the College orchard); Ben Davis, May 4th; Baldwin, May 5th; (Yellow Newtown Pippin, no tree in the College orchard); Northern Spy, May 12th.

On closer comparison it is found at Hood River that, while there is uniformly seven days difference between full blossom of Early Harvest and Red Astrachan on one side, and Jonathan, Spitzenberg, Ben Davis and Baldwin on the other; at Cove there were two

* This idea corresponds closely with that expressed on page 17 under the caption, Tillage.

days difference between the first two, and as between these and the other four the time varied from nine to twenty days, and at the same time the variations between the members of this second group were from four to nine days.

At Hood River the Yellow Newtown preceded the Northern Spy by two days. At Cove this order was reversed with a difference of five days.*

While it is reasonable to think that no very great value can be attached to the observations of one or two years, it is evident from the records kept at Corvallis, though they are very incomplete, that a very variable relation exists from year to year not only between different varieties, but between the various phases of development in the same variety, for example: In 1896, Delaware Red and Dominie were in full blossom seventeen days apart, but in 1897 they were in full blossom only two days apart. Then in the record of Fameuse we find a variation between the opening of first blossoms and full blossom to vary from seven days in 1896; to three days in 1897; to twelve days in 1898; to nine days in 1900; to fourteen days in 1901 and to eight days in 1903. Or in other words the period from the opening of first blossoms to the time when the tree is in full blossom may vary from year to year, from three to fourteen days, which is equivalent to the variations between different varieties doing the same work.

An interesting note is made by comparing the average of time that elapses between first blossoms and full blossoms in different sections. From the table of Cove data it will be observed that the minimum time is fifteen days, the maximum is twenty days, the average fifteen and three-fourths, approximately. For the same year at Corvallis the minimum was four days, the maximum was eleven days, and the average less than seven days. These latter figures are upon data derived from the blossoming of all varieties and may be counted of little value for purposes of comparison except as a matter of record at this time.

*It is quite probable that some slight variation in these dates may be accounted for through the difference of individuality of the observers, but it is improbable that it can all be accounted for in this manner when we take into account the personality of the observers in these two instances.

VARIETY.

VARIETY.	1886			1887			1888			1900			1901			1902			1903		
	*A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Autumn Sweet.....							4.24	5.3	0	4.15	4.21	5.1	4.28	5.8	5.16				4.28	5.5	0
American.....							4.28	5.4	0				4.27	5.7	5.14				4.27	5.1	0
Abram.....							4.21	4.80	0	4.9	4.20	5.8	4.25	5.7	5.11				4.26	5.1	0
Arkansas.....																			4.26	5.1	0
Baldwin.....	4.17	4.80	0	4.29	5.3	0	4.19	5.2	0	4.16	5.1	5.10	4.29	5.9	5.17				4.27	5.2	0
Bailey Sweet.....				4.30	5.3	0	4.22	5.5	0	4.17	5.2	5.10				5.8	6.10		5.8	6.10	0
Bethlemite.....				4.23	4.26	0	4.18	4.30	0	4.28	5.4	5.16	4.20	4.29	5.9				4.28	5.5	0
Briar (crab).....							4.22	5.4	0				4.20	4.29	5.9				4.25	5.3	0
Bottle Greening.....				4.28	5.1	0	4.25	5.9	0							4.28	5.4		4.28	5.4	0
Blenheim Orange.....							4.22	5.4	0	4.13	4.21	5.1	4.20	5.3	5.12	4.25	5.7	5.19	4.24	4.30	0
Beilflower, Y.....							4.22	4.30	0				4.19	5.4	5.9	4.28	5.8	0	4.26	5.3	0
Black Twig.....							4.25	5.6	0				4.18	5.5	5.11	4.29	5.8	5.19	4.27	5.2	0
Bismarck.....							4.22	5.6	0										4.28	5.3	0
Canada Sweet.....							4.19	5.5	0	4.7	4.18	4.25	4.22	4.29	5.3				4.28	5.4	0
Canada Relette.....							4.17	5.3	0	4.15	4.23	5.3	4.26	5.2	5.19				4.29	5.4	0
Charlottenthaler.....										4.15	4.28	5.8							4.27	5.10	0
Calvert.....							4.25	5.4	0										4.29	5.4	0
Canada Red.....																			4.25	5.6	0
Deleware.....							4.22	5.1	0	4.7	4.18	4.30	4.20	4.29	5.8						0
Dutch Mignon.....	4.26	5.11	0	4.17	4.28	0	4.22	5.6	0	4.12	4.18	5.1	4.22	5.3	5.11						0
Deleware Red.....	4.16	4.24	0	4.15	4.26	0	4.12	4.22	0	4.3	4.15	4.28	4.16	4.28	5.7						0
Portme.....																4.18	4.28		4.22	4.29	0
Early Harvest.....							5.3	5.11	0	4.25	5.4	0	4.12	4.20	4.28	4.17	4.28	5.10			0
Early Strawberry.....							4.19	4.23	0	4.16	4.28	0	4.6	4.15	4.28	4.16	4.29	5.7			0
Early Pippin.....	4.17	5.7	0																		0
Early Wine.....				4.25	5.6	0	4.22	5.1	0	4.7	4.15	4.29	4.16	4.29	5.11	4.33	4.25	5.6	4.34	5.2	0
Early Water.....				4.22	4.23	0	4.18	5.4	0	4.7	4.15	4.25	4.18	4.27	5.10				4.28	5.4	0
Early Jannetting.....				4.20	5.1	0	4.16	5.4	0	4.10	4.20	5.10	4.20	5.2	5.6						0
Fancuse.....	4.22	4.29	0							4.16	4.21	5.8	4.22	5.10	5.17				4.29	5.4	0
Gano.....										4.9									4.28	5.6	0
Grimes Golden.....							4.19	5.1	0	4.15	4.20	4.30	4.19	5.2	5.8				4.28	5.6	0
Green Sweet.....	4.14	4.27	0	4.27	4.29	0	4.25	5.1	0	4.15	4.18	4.30	4.20	4.29	5.11				4.27	5.5	0
Golden Sweet.....				4.19	4.29	0	4.22	4.30	0	4.9	4.18	5.1	4.20	4.29	5.8						0
Gravenstein.....							4.13	4.26	0	4.10	4.16	4.28	4.17	4.25	5.2				4.27	5.5	0
Hoover.....				4.29	5.3	0	4.29	5.9	0												0
Hydes Keeper.....							4.20	5.2	0	4.7	4.18	4.28	4.22	5.3	5.8	5.14	5.6	5.14	4.27	5.3	0
Holland Beauty.....							4.11	4.22	0	4.11	4.22	4.30	4.26	5.10	5.20				4.25	4.30	0
Holland Pippin.....	4.17	5.2	0	4.20	4.26	0	4.25	5.5	0	4.15	4.26	5.1	4.23	5.9	5.18				4.29	5.5	0
Hyslop (crab).....	4.13	4.20	0	4.20	4.26	0	4.18	4.24	0	4.9	4.19	4.28	4.21	4.29	5.8				4.27	5.3	0

VARIETY.	1896			1897			1898			1900			1901			1902			1903		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Haas							4.17	4.97	0	4.6	4.16	4.25	4.16	4.28	5.6				4.28	4.30	0
Jonathan							4.24	5.5	0										4.27	5.1	0
Janetling							4.15	5.23	0										4.27	5.1	0
Lewitts Red	4.24	5.7	0	4.20	5.3	0	4.25	5.2	0	4.15	4.23	5.3							5.2	5.9	0
Kentucky Red Streak							4.24	5.50	0										4.28	5.4	0
King				4.28	5.8	0	4.22	5.2	0	4.13	4.20	5.2	4.19	5.5	5.10	5.1	5.9	0	4.28	5.4	0
Kewick Codlin							4.13	5.1	0	4.9	4.18	4.25	4.17	4.28	5.8				4.28	5.4	0
Longfellow	4.4	4.15	0				4.24	5.8	0	4.8	4.15	5.1	4.16	4.28	5.8				4.28	5.4	0
Limbertwig							4.23	5.8	0	4.7	4.15	4.24	4.16	4.29	5.8	4.28	5.7	5.16	4.27	5.3	0
Mann							4.23	5.8	0										4.28	5.5	0
Melon	4.19	5.3	0				4.23	5.8	0	4.16	4.28	5.3	5.2	5.8	5.15						
Monson							4.22	5.7	0	4.10	4.20	5.1	4.22	5.2	5.9						
McNabon							4.22	5.6	0										4.28	5.3	0
Maiden Blush (Winter)	4.20	5.7	0	4.29	5.3	0	4.22	5.6	0	4.9	4.16	5.1	4.21	5	5.10	5.4	5.8	5.18	4.28	5.4	0
Martha	4.13	4.23	0	4.19	4.29	0	4.16	4.25	0	4.7	4.16	4.30	4.17	4.27	5.8				4.28	5.3	0
Montreal (crab)	4.9	4.20	0	4.18	5.1	0	4.16	5.1	0	4.6	4.16	4.25	4.17	5.2	5.10	4.20	5.8	5.17	4.26	5.2	0
Minnesota (crab)							4.16	5.2	0							4.25	5.4	5.15			
Missouri Pippin	4.24	5.13	0	4.20	4.29	0	4.23	5.2	0	4.13	4.21	4.26	4.17	5.4	5.12						
May				4.15	4.17	0	4.12	4.22	0	4.17	4.28	5.8	5.1	5.10	5.20				5.8	5.7	0
Oregon Crab							4.18	4.30	0	4.8	4.13	4.18	4.16	4.25	5.2				4.21	4.25	0
Ortley				4.14	4.20	0	4.13	4.25	0	4.9	4.19	4.28	4.22	5.2	5.8				4.29	5.4	0
Oldenburg							4.29	5.5	0	4.11	4.12	4.20	4.18	4.25	5.7				4.24	5.2	0
Pryor (Red)							4.23	5.8	0	4.15	4.23	5.2	4.23	5.5	5.13	5.5	5.10	5.17	4.27	5.2	0
Pewaukee	4.25	5.10	0													4.28	5.6	5.19	4.29	5.5	0
Paradise Sweet				4.23	4.26	0	4.24	5.3	0	4.6	4.20	4.28	4.22	5.2	5.7				5.1	5.6	0
Pumpkin Russett				4.20	4.29	0	4.24	5.3	0	4.12	4.18	5.2	4.20	5.7	5.16				4.28	5.4	0
Palmer				5.8	5.10	0	4.27	5.8	0	4.23	5.1	5.3	5.7	5.14	5.20				5.6	5.10	0
Red Astrachan	4.16	4.20	0	4.23	4.26	0	4.23	5.6	0	4.7	4.12	4.20	4.19	4.22	5.1				5.21	4.28	0
Roxbury							4.22	5.2	0	4.19	0	5.4	4.28	5.6	5.18						
Rock Pippin	4.27	5.6	0				4.22	5.2	0	4.15	4.20	4.28	4.22	4.26	5.7				4.28	5.5	0
Romanite	4.19	5.6	0	4.21	4.30	0	4.19	5.9	0	4.9	4.27	4.29	5.1	5.9	5.16						
Ralls										4.7	4.16	4.25	4.21	4.26	5.1						
Red Canada	4.22	5.7	0				4.26	5.4	0	4.15	4.28	5.4	0	4.16	5.4	5.5	5.10	5.19			
Rambo										4.15	4.28	5.6	4.20	5.3	5.11				5.1	5.9	0
Red Winter							4.22	5.4	0												
Rhode Island Greening				4.20	4.23	0	4.22	5.4	0	4.13	4.20	5.5	4.22	5.2	5.9						
Siberian (crab)	4.5	4.15	0				4.22	5.2	0										4.26	4.30	0
September (crab)							4.22	5.2	0												
St. Lawrence							4.18	4.26	0	4.9	4.16	5.1	4.17	4.26	5.6						
Steeles Red							4.22	5.2	0				4.21	4.29	5.6	5.1	5.9	5.17	4.29	5.2	0

VARIETY.	1896			1897			1898			1900			1901			1902			1908		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Sweet Bough.....	4.26	5.7	0	4.21	4.29	0	4.22	5.2	0	4.9	4.20	5.2	4.20	5.3	5.10	4.27	5.4	0	4.27	5.4	0
Shiawasee.....	4.26	5.7	0	4.22	4.27	0	4.18	5.2	0	4.7	4.20	4.29	4.20	4.29	5.7	4.28	5.5	0	4.28	5.5	0
Spy (N.).....	4.16	4.25	0	4.25	4.27	0	4.24	5.4	0	4.28	4.28	5.3	4.18	4.28	5.9	4.28	5.5	0	4.28	5.5	0
Salome.....	4.16	4.25	0	4.27	4.28	0	4.18	4.28	0	4.10	4.16	5.1	4.18	4.28	5.9	4.27	5.4	0	4.27	5.4	0
Scotts Winter.....	4.16	4.25	0	4.27	4.28	0	4.18	4.28	0	4.10	4.16	5.1	4.18	4.28	5.9	4.27	5.4	0	4.27	5.4	0
Summer Queen.....	4.16	4.25	0	4.27	4.28	0	4.18	4.28	0	4.10	4.16	5.1	4.18	4.28	5.9	4.27	5.4	0	4.27	5.4	0
Souland (crab).....	4.15	4.20	0	4.28	4.29	0	4.18	4.29	0	4.8	4.19	5.1	4.22	5.2	5.10	4.28	5.4	0	4.28	5.4	0
Stark.....	4.15	4.20	0	4.28	4.29	0	4.18	4.29	0	4.8	4.19	5.1	4.22	5.2	5.10	4.28	5.4	0	4.28	5.4	0
Taylor.....	4.26	5.7	0	4.26	5.4	0	4.26	5.4	0	4.9	4.16	5.1	4.20	5.4	5.12	4.27	5.8	0	4.27	5.8	0
Tetofsky.....	4.16	4.19	0	4.16	4.19	0	4.16	4.19	0	4.16	4.19	0	4.16	4.24	5.2	4.22	5.9	0	4.22	5.9	0
Tallman Sweet.....	4.16	4.23	0	4.16	4.23	0	4.16	4.23	0	4.16	4.23	0	4.16	4.23	0	4.16	4.23	0	4.16	4.23	0
Transcendent (crab).....	4.22	5.8	0	4.21	4.26	0	4.22	5.8	0	4.4	4.15	4.28	4.16	4.26	5.4	4.21	4.27	0	4.21	4.27	0
Twenty Ounce.....	4.20	5.8	0	4.18	4.21	0	4.19	5.2	0	4.9	4.20	4.28	4.20	4.28	5.7	4.27	5.4	0	4.27	5.4	0
Transparent (Yellow).....	4.20	5.8	0	4.18	4.21	0	4.19	5.2	0	4.6	4.16	4.25	4.20	5.6	5.11	4.29	5.6	0	4.29	5.6	0
Willow.....	4.21	4.24	0	4.21	4.24	0	4.21	4.24	0	4.16	4.24	5.1	4.20	4.80	5.20	4.20	5.2	0	4.20	5.2	0
Wolf River.....	4.21	4.24	0	4.21	4.24	0	4.21	4.24	0	4.16	4.24	5.1	4.20	4.80	5.20	4.20	5.2	0	4.20	5.2	0
Winesap.....	4.21	4.24	0	4.21	4.24	0	4.21	4.24	0	4.16	4.24	5.1	4.20	4.80	5.20	4.20	5.2	0	4.20	5.2	0
White Belledflower.....	4.21	4.24	0	4.21	4.24	0	4.21	4.24	0	4.16	4.24	5.1	4.20	4.80	5.20	4.20	5.2	0	4.20	5.2	0
Willow Twig.....	4.21	4.24	0	4.21	4.24	0	4.21	4.24	0	4.16	4.24	5.1	4.20	4.80	5.20	4.20	5.2	0	4.20	5.2	0
Whitney (crab).....	4.21	4.24	0	4.21	4.24	0	4.21	4.24	0	4.16	4.24	5.1	4.20	4.80	5.20	4.20	5.2	0	4.20	5.2	0
Walbridge.....	4.21	4.24	0	4.21	4.24	0	4.21	4.24	0	4.16	4.24	5.1	4.20	4.80	5.20	4.20	5.2	0	4.20	5.2	0
Waxen.....	4.21	4.24	0	4.21	4.24	0	4.21	4.24	0	4.16	4.24	5.1	4.20	4.80	5.20	4.20	5.2	0	4.20	5.2	0
White Pippin.....	4.21	4.24	0	4.21	4.24	0	4.21	4.24	0	4.16	4.24	5.1	4.20	4.80	5.20	4.20	5.2	0	4.20	5.2	0
Wealthy.....	4.26	5.7	0	4.27	4.29	0	4.22	5.6	0	4.8	4.21	4.30	4.16	5.4	5.10	4.27	5.4	0	4.27	5.4	0
Western Beauty.....	4.26	5.7	0	4.27	4.29	0	4.22	5.6	0	4.8	4.21	4.30	4.16	5.4	5.10	4.27	5.4	0	4.27	5.4	0
Wagner.....	4.26	5.8	0	4.27	4.29	0	4.22	5.6	0	4.8	4.21	4.30	4.16	5.4	5.10	4.27	5.4	0	4.27	5.4	0
York Imperial.....	5.4	5.11	0	4.28	4.28	0	4.25	5.7	0	4.15	4.24	5.2	4.22	5.6	5.16	4.30	5.8	0	4.30	5.8	0

*A, B, and C stand for first blossoms, full blossom, and fall of blossoms, respectively.
 †The dates read for example: 4.26, April 26; 5.7, May 7; 0, no record kept.

Observations upon the blossoming of apple trees in the Rogue River valley,
1903, by Olwell Bros. *

Variety	First Blossom	Full Blossom
Gravenstein.....	4.12	4.25
Yellow Newtown.....	4.20	5.4
Ben Davis.....	4.20	4.28
Winesap.....	4.24	4.30
Spitzenburg.....	4.24	5.2

* Courtesy of the State Board of Horticulture.

Observations upon the blossoming of apple trees in the Hood River valley
for 1902 and 1903, by E. L. Smith.

Variety	Full Blossom 1902	Full Blossom 1903
Baldwin.....	May 8	May 8
Ben Davis.....	8	8
Canada Reinette.....	6	6
Deleware Red.....	6	6
Early Harvest.....	8	8
Esopus Spitzenburg.....	1	1
Gravenstein.....	1	1
Grimes Golden.....	4	4
Jonathan.....	8	8
Missouri Pippin.....	8	8
Red Astrachan.....	4	1
Red Russian.....	1	1
Salome.....	8	8
Stark.....	8	8
Swaar.....	8	8
Transcendent (Crab).....	4	4
Wagner.....	6	-
Winesap.....	4	4
Yellow Transparent.....	4	4
Yellow Newtown.....	10	10
N. Spy.....		12

Observations upon the blossoming of apple trees in Grand Ronde valley, 1903,
by Karl J. Stackland.

Variety	First Blossom	Full Blossom
Arkansas.....	May 1	May 21
Baldwin.....	1	16
Ben Davis.....	5	20
Early Harvest.....	April 20	5
Esopus Spitzenburg.....	May 10	25
Gano.....	5	20
Jonathan.....	5	20
King.....	1	16
Northern Spy.....	5	20
Oldenburg.....	10	25
Oregon.....	April 20	9
Red Astrachan.....	May 3	20
Rhode Island Greening.....	5	20
Rome Beauty.....	April 20	7
Winesap.....	May 15	30
Yellow Newtown.....	10	25
York Imperial.....	15	30

TILLAGE.

Modern soil tillage has in view too chief ends, namely, to improve the mechanical condition, and to increase chemical and biological activities or changes. In the growing of shallow rooted crops, tillage aims to serve both purposes equally, but in the growth of the orchard crop the chief aim is the latter purpose, that is, to induce vigorous chemical and biological changes. The roots of the orchard crop feed so deeply in the soil that tillage operations can not be expected to greatly modify the physical conditions, except upon the surface. This is one of the leading reasons why a deep, porous, well drained soil primarily should be selected for an orchard site. Plowing, subsoiling, harrowing and cultivating break up the soil to a depth suitable for the root systems of the cereal, root and forage crops, but such operations only serve to help the orchard crop for the first few years of its growth. By the time the tree comes into bearing its principal roots should be feeding in the soil far beneath the reach of the plow and cultivator, and besides havoc would be wrought if tillage tools were to reach among the roots for the purpose of putting the soil in better physical conditions. This phase of the subject need receive no further consideration here save this observation: The importance of the first preparation of the soil for the reception of the trees is not to be underrated. Deep, thorough tillage of a well broken and subdued soil is an essential to success in the first steps of orcharding. When the young tree is transplanted it undergoes a severe check to its vegetative functions. Too much cannot be done by way of putting the soil in a fit condition to favor rapid and unobstructed root growth. A point always to be kept in mind when one is dealing with the problems of tree life is that a living working tree requires a more or less definite amount of energy to produce new wood and leaf-growth and a crop of fruit. Any object that obstructs in any way the freedom of growth, or checks the supply of available food materials reduces the tree's supply of energy and thus retards its growth or croppage. Clods, rocks, puddled earth particles, coarse vegetable matter and other materials may offer obstructions to the course of growth of the roots, or render the food supply more difficult to obtain; all these conditions are hindrances to the plant's best development. So much of the plant's energy, best efforts, vigor, is used in overcoming these obstacles that frequently the young tree fails to

survive the shock of being transplanted. Every time a young root turns out of a quite direct course in its growth there is lost plant effort; every time an absorbing rootlet is obliged to encompass a clod instead of penetrating between fine particles, more plant energy is wasted; every time the roots of plants are surrounded with clods, lumps and soil masses so large that the water of the soil cannot be conserved against evaporation during periods of dry, warm weather, the root system receives a check which too often results disastrously to the young tree; if there is too much half-rotted vegetable matter in the soil when the young roots begin to push out the heat of this during the process of further decay may rise so high as to kill the tender young roots; or, it may drive off the soil water to such an extent that not enough remains to make the mineral plant food of the soil available. For the use of most plants mineral substances must be in very weak solutions, as one part of mineral matter to ten thousand parts of water or even as weak as one, in fifteen thousand parts of water.

All these conditions, so unfavorable to tree growth, are eliminated by such thorough tillage as should be given the soil for at least one year, and preferably two or three years preparatory to the planting out of the young trees.

A thoroughly subdued, deep, fertile, friable soil worked fine is an ideal place in which to transplant a young tree, and under such conditions there is little danger of its not enduring the change.

Tillage, for the purpose of inducing chemical and biological changes in the soil, is all important to the orchardist, or other soil tiller for that matter. It has been long known to students of soils that there are two classes of changes constantly going on in ordinary agricultural soils independent of tillage operations, but both of which may be greatly augmented by judicious tillage. Chemical changes in the soil result more or less directly in the release of mineral substances needed by the plant. These changes are hastened and increased by the presence in the soil of water, heat and air in sufficient quantities and by the stirring and consequent changing of position of the soil particles. These requirements, or rather desirable conditions, are fully induced by proper tillage operations. By pulverizing the soil, air is admitted; this warms the soil; the water of the soil during the dryer part of the season, by this same operation, is kept from passing off in the form of vapor as readily as it otherwise would, and while the position of the soil particles is greatly changed, their size is also reduced.

The biological changes taking place in the soil and which are likewise greatly facilitated by good tillage, are various and quite imperfectly understood. A few of the more important ones like nitrification, have received much attention in recent years and results of much moment to the soil tiller are being reached through the biological investigations of the soil now being carried on in nearly every scientific center.

CULTIVATION.

Tillage operations generally discussed as cultivation are as variable as the individuals that are engaged in orcharding. Some rely chiefly upon the old-time plow, but more count the modern disk-harrow the staple tool. These latter followed by clod-crushers, acme harrows, and scarifiers do most effective work under the usual soil conditions to be found in Oregon orchards.

One plowing in alternate years is held to be sufficient for all the mellow soils, though some find that disking alone is all sufficient. Upon the clayey soils most cultivators deem one plowing a year desirable and in this practice the two operations of contiguous years are at right angles, i. e. one year plow east and west; next year, north and south. Plowings or diskings are usually followed by clod crusher or pulverizing harrow. The first operation is usually just after the blossoms fall.* Then at intervals of two or three weeks the pulverizing harrow follows until the middle of July or first of August. By this time or even by the middle of June, the surface soil from two to three inches deep is a perfect dust, the so-called

* Recently some discussion has been provoked by the statement that the first plowing should precede blossoming. The reason assigned for this is that the stirring of the soil at that time induces a more vigorous root activity thus enabling the tree through this stimulus to set more fruit than it otherwise would. The issue is debatable at least, and the position, probably erroneous. No experimental evidence of unquestioned character has been produced; and it is not yet credited by the known principles of vegetable physiology: Sap pressure does not indicate the extent to which elaborated food is present, such as young buds or blossoms require. What a bud needs at the time of opening is a good supply of digestible food material. This food material is prepared the year before. It would seem that if a bud is low in vitality it could hardly be expected that the overcharging of it with water and crude mineral matter would increase its vitality, i. e. make it do more work by way of fertilization of flowers.

It is a generally accepted view that the pollen grain is normally rich in proteid matters, i. e. substances rich in nitrogen, sulphur and phosphorus, and that for the growth that takes place at the time of fertilization elaborated carbon foods are chiefly required. This carbon food material is only developed in the presence of green leaves, i. e. the year preceding. Thus it appears that early tillage operations have no direct bearing upon the fertilization of the blossoms. Tillage indirectly, however, might be beneficial to the tree at this early period through the aeration of the soil whereby it would become warmer and thus more suitable for root activity. This induced root-activity would cause an increased sap pressure and this in its turn would have a measurable influence upon the period of cell activity in the region of the blossoms, but it is very doubtful if it could add anything to the vitality or vigor of the blossoms and especially the organs of fertilization, stamens and pistils.

If a crop of fruit is wanted next year preparation for it must be made this year while the tree is growing and particularly while it is storing food during the latter part of the vegetative period. Feed the tree well this year; keep it clean and free from pests, and other conditions, as climate, being favorable next year, the tree will yield a crop in return for your judicious care.

"dust mulch" or "earth-blanket" a most important factor in the conservation of soil moisture. Where ferns or some other deep rooted perennial plants persist in playing the part of weeds (See Fig. 19) it is often necessary to go over the ground at intervals of ten days with a tool known as a scarifier. By removing the tops at frequent intervals the roots finally become exhausted, and as there is left no other means for the plant to propagate itself it disappears. It frequently requires from three to four years to rid a piece of land of a well established crop of ferns. Occasionally one hears that trees should not be planted on a fern ridge because the plant is such a



Fig. 19. Ferns as weeds in Western Oregon orchards.

pest in the orchard. In truth fern ridges when once subdued are the very best of sites for orchard purposes. Ferns only grow abundantly on well drained soil. The ramifications of their underground stems and the ultimate death and decay of these very materially aid in oxidizing and aerating the soil, to the depth of two feet, or even more. This oxidization and aeration are highly important processes in the biological functionings of the soil, and most useful factors in rendering the plant food of the soil available for tree growth.

COVER CROPS.

This is a phase of orchard management that has received little attention as yet. Speaking more particularly of Western Oregon it may be said: Thus far our orchards that are thoroughly tilled have shown no especial need of service in the directions in which a cover crop would aid them, but the time is approaching when such conditions will no longer exist. Thorough tillage increases oxidation in the soil. The humus burns away as it were and need for material to replace the original supply will be manifest, in a dryer, harsher soil; sometimes heavier; sometimes lighter; in a soil that will be cloddy and intractable, generally throughout Western Oregon. This material can be obtained at least expense by means of cover crops, as oats, wheat, rye, vetch, clover, mustard, and the like.

As to the functions of a cover crop altogether, it may be well to quote from bulletin No. 61, of the Delaware station, which says:

"WHAT DOES A COVER CROP DO?"

(1.) If sown at the proper time, about August 1 if weather conditions are favorable, it competes with the trees for soil moisture and plant food. The supply of moisture and food to the trees is lessened and their growth is checked. This is desirable, because at that time the trees should stop growing and ripen their wood for the winter.*

(2.) It catches soluble nitrates late in the fall when root action of the trees has nearly or quite ceased, thus much plant food is saved rather than allowed to escape in drainage.

(3.) It prevents erosion of the surface soil by catching the rains as they descend and by conducting them into the soil. This is in contrast to streams of water flowing over the bare surface and cutting channels for the escape of surplus water. It also holds the snow of winter which adds to the efficiency of the protection.

(4.) It protects the ground from frost to a certain extent, that is, actual tests have proven that ground protected by live cover crops during the winter does not freeze so deep as does bare ground.

(5.) In the spring it catches soluble nitrates that might leach out of the soil before active root action of the tree begins.

*This statement applies more particularly to young trees. Bearing trees with us would need no such check and it would be well to sow the cover later, thus not shortening the supply of water for the fruit.

(6.) It pumps the surplus water out of the soil early in spring so that the ground warms up and may be plowed earlier than if no cover crop were used.

(7.) When plowed under these crops add enormous amounts of vegetable matter or humus to the soil. The humus improves the mechanical condition of the ground by loosening up the soil particles; it increases the water-holding power of the soil, provides a favorable home for soil bacteria, furnishes elements of plant food in available form, and assists in breaking up chemical compounds of plant food which would otherwise remain unavailable.

(8.) Experience has shown that the continued use of cover crops will, to a certain extent, make heavy land lighter and light land heavier. This is an immense advantage in practical orchard operations."

Cover crops may be grouped into two—possibly three—classes: the leguminous, as peas, beans, alfalfa, clovers, vetches, cow peas, and the like; the potash gatherers, as turnips, and rape and probably kale, and the non-leguminous as rye, wheat, oats, barley, mustard, buckwheat, rape, millet, corn, and others.

The first class are the so-called nitrogen-gatherers, and may be considered as fertilizers as well as cover crops. One of the most important materials used in plant growth is nitrogen. This material bought as a commercial fertilizer or applied with barnyard compost is quite expensive. It abounds in the air as one of the principal gases and, so far as we know at present, this gas can be used directly only by leguminous plants. Or, in other words, this free nitrogen of the air, which is inexhaustible, is made available as plant food through the agency of leguminous plants, while other plants must get the nitrogen required for their growth from the supply in the soil or that set free by decomposing plants or animals. Then, since nitrogen is one of the most valuable of plant foods, it is evident that any plant which is able to get its supply of this element from the inexhaustible stock of the air must be doubly valuable as a cover crop.

- By recent analyses* it is made evident that certain plants, cow-horn turnips and rape, are rich in potash. It thus appears that such crops used for cover purposes might put the potash supplies of the soil within easier reach of the tree. If the soil of an orchard is rich in humus and nitrogen, a cover crop of potash-gathering

* Delaware station.

plants, if from such knowledge as we have of them, we may call them such, would be the logical one to use. In this connection it may be well to note the fact that Scotch kale, a plant closely related to the turnip, has been giving some remarkable yields in Western Oregon, as a forage plant for dairy purposes. It seems probable that this plant would do efficient service as a cover crop on soils in good tilth and well supplied with humus. And since potash tends to hasten the maturity of a crop, increase the sugar content, and heighten the color, indirectly, at least as a consequence of earlier maturity, its importance to the fruit-grower in the moister sections of our state becomes evident, and any secondary or catch crop that will render the potash of the soil more readily available for the trees is to be held as a useful factor in orcharding. But, as before stated, only practical tests upon the site will determine the course to be followed in each instance. The crops, rotation or tillage, will depend upon the local conditions and the successful orchardist will be the intelligent experimenter in these matters.

A rotation of cover crops is as important as a rotation of general farm crops. The constant use of a leguminous crop would tend to make the soil very rich in available nitrogenous materials. This would induce excessive wood and foliage growth at the expense of flowers and fruit. To off-set this tendency non-nitrogenous crops should be grown in rotation with the leguminous crops, as often as the trees appear to be growing too vigorously at the expense of fruit production.

Then we must not lose sight of the fact that though a cover crop may not, of itself, use the free nitrogen of the air, it will avail itself of such nitrogen material as is obtainable in the soil during its period of growth, and, as this is at a time when the dormant tree could make no use of such nitrogen material, which, if not used, soon escapes as a waste by leaching from the soil, it is seen that the cover crop thus becomes a saver of nitrogen as well as other substances and thus performs a work as important as that of a nitrogen gatherer under the circumstances.

In Western Oregon orchards in particular, not a foot of soil should remain uncovered or bare of plant growth from the time the crop is fully grown to the time when the fruit begins to form the following spring. The warm winter temperature, together with the rainfall, results in a set of conditions quite suitable for the growth

of many hardy plants. Under the same conditions biological and chemical changes in the soil are setting free much soluble plant food material. This material if not used by active plants on the ground, will be wasted very largely by surface washing or leaching through the drainage system. An active crop saves this waste; puts it in such form as can be more readily used by the trees when they become active in the spring. And thus, while saving what would otherwise be lost to the soil tiller, the cover crop performs a preliminary or preparatory work for the trees, getting ready for their use early in the spring a quantity of predigested breakfast food as it were. And, as with the human, the more substantial the breakfast the better the start in the season's work.

While the list of plants that may be grown for cover purposes is quite long, each locality, and each grower, will find that local conditions and personal requirements will render some more suitable than others for his purpose. So far as reports have been made the vetch—*Vicia sativa*—appears to give the best results in Western Oregon. L. T. Reynolds says: * "Our first test of cover crops was in 1896, when we sowed crimson clover. It did not prove suitable for our climate. The common vetch has been found to meet all requirements. It can be sown later than crimson clover; is nearly always a good stand; makes a good growth during the winter, and pushes forward rapidly in the spring, so that one can have a growth of two to three feet in height to turn under by May the first. As such luxuriant growth renders it somewhat difficult to plow in, we have found it convenient to sow the seed only one way between the trees, leaving about three feet in the tree row unsown. Sown in this way it requires about fifty pounds of seed per acre, and it can be readily plowed under." †

"In an orchard of young trees making vigorous growth the vetch can be sown in February and plowed under in June, but under such conditions I should hardly consider a cover crop necessary."

In bulletin No. 40 (1896) of this Station the following statements are found: Speaking of a twenty-five acre tract, in a large prune

* Oregon report 1903.

† In a letter to the writer dated December 24, 1903, Mr. Reynolds speaks further of the vetch as a cover crop. "In ordinary years, I would say the vetch should not be sown later than December 1st. I prefer to sow it in September and October as it then gets a good start and makes a rapid growth as soon as warm weather comes in the spring and enables one to turn under a good crop by the early part of May. It then rots quickly and assists in preserving soil moisture together with its other functions. If a heavy growth is turned under in June, the soil moisture is usually too low to permit of ready decay and thus the vetch not only does not yield plant food, but it renders the soil dryer and in this way works an injury to the orchard crop."

orchard, that had become covered with a rank growth of wild mustard, the author said: "The soil of this mustard strip remained moist and friable all summer through, and with one-third the tillage it presented a more favorable condition for tree growth, as shown by the vigor of the trees, than any other part of the orchard under otherwise similar treatment."

If the supply of nitrogen in the soil is quite sufficient there are some advantages in a mustard crop not found in others. The crop may be pastured in the winter, and if not plowed under too early in the spring, ample seed will be formed to renew the crop the following year. The seed, after lying dormant during the summer and being thoroughly mixed with the soil through the tillage operations, will germinate with the first fall rains and one year with another the plant makes a good stand before cold weather sets in.

With a small orchard and on a soil moderately supplied with humus and nitrogen, vetches for silage purposes might be grown with a double effect. By cutting the crop about the first of May, putting it in the silo and plowing under the stubble the double benefits of a cover crop and a forage crop might be obtained three years out of five in Western Oregon. Some seasons of moderate rainfall a drawback to this practice would be encountered in the excessive dryness of the surface soil induced by the growing cover crop. This condition would render plowing and pulverizing the soil more difficult and expensive. In such instances the whole crop could be turned under while the soil is still mellow.

For early spring pasturage or for humus, other plants may be used, as wheat, winter oats, rye and kale. Even though the soil may not need the humus of a cover crop, such a crop on the soil during the resting period of the trees is an advantage to the orchard and the orchardist. A crop growing on the soil during our warm, wet winters, gathers for its use a quantity of food material that otherwise would escape through leaching or surface washing. This crop can be pastured in the early spring months and such pasturage would be net gain less the cost of putting in the crop. Orchard lands that are sufficiently supplied with humus and as well drained as they should be for such purposes, would in no wise suffer by being pastured with sheep or swine during the early spring months. Other stock is liable to do more or less damage to the tops of the trees, especially in the young orchards, and accordingly should not be allowed in the orchard. Care must be exercised in

pasturing young orchards with sheep or swine, for in the event of a shortage of the food crop, they will attack the trees and may do much damage by girdling.

PRUNING.

"Pruning is commonly resorted to only for the purpose of increasing the vigor of feeble trees, or to regulate or improve the form of healthy and luxuriant trees."—DOWNING.

"The course to follow in pruning will depend upon which of the two leading objects, vigor of growth or fruitfulness, is in view. Pruning at one season will produce one result, while pruning at another will yield a different result, hence prune in winter for wood and summer for fruit."—WARDER.



Fig. 20. A sprawling top..... (See Fig. 21)

"Bad pruning of the apple is disposed to give an alternate production of fruit."—PASSY. (See Figs. 20 and 21.)

Pruning and training should go hand in hand in orchard-making. To prune is to remove surplus or undesirable wood; to train is to evolve an ideal or correct form as a result of the pruning, but it should be remembered that the form will vary not only with the several kinds of trees but also with the different varieties of the same kind, as is well illustrated, for example, by the Northern Spy

and Grimes Golden. The pruner must have the ideal form in mind and then prune accordingly. A brief discussion of the philosophy of tree growth may serve to aid the beginner in getting a better idea of how to proceed in the work of pruning. In the first place it must be kept well in mind that the tree is a community organization. Each bud is measurably independent—it is an individual. Every individual is struggling to make the most of its opportunities. Every bud that is enabled to develop into a branch becomes an important factor in the plant's economy, and its impor-



Fig. 21.breaks when laden with a good crop.

tance will depend upon the magnitude of its growth, and this depends very largely upon position and period of formation. Every tree is endowed with an impulse to grow upward and outward. This impulse is governed very largely by the influences surrounding the tree as light, heat, moisture, wind, food supplies and room. One of the chief influences determining the form of the top is light. Every bud, every shoot, every branch, for its best development, needs ample light, other conditions being favorable, that bud or branch that has the best light relation will make the best growth.

The best light relation normally is to be found about the top and outside of the trees' head. As a result of this better light relation growth begins earlier in the spring and continues later in the fall. The terminal buds are the last to go into the resting stage; the lateral ones, and especially those well in toward the center, start last and stop first. The growth impulse gradually weakens in these inner twigs and shoots and many of them yield to their fellow branches on the outside. This process even goes to such an extent that many buds upon the inner and lower branches fail to develop into shoots at all, and still further, the lower buds upon a thrifty growing outside shoot often remain dormant. Thus it is, that, practically, only the later formed buds of a season are the ones that develop into new parts. Another of the active influences in the tree's growth is the water and mineral matter supplied by the roots. This supply as it is forced or drawn upward through the tissues of the stems and branches, endeavors to follow the lines of least resistance. Usually a straight line offers the best course, hence, we commonly see the erect, straight branches or shoots growing fastest, and we come to think of the chief growth of a tree as being upward and outward. If the tree is crowded by its fellows, its lateral light relations will be poor, and accordingly growth will be chiefly upward.

All this results in what amounts to being a struggle for existence. Every bud and branch is using its best effort to get the best light and food supply. Some must yield by either becoming dormant or dying after a brief existence. This is nature's way of pruning. We see splendid examples of the process in thickets of young firs, and in the dense tops of old maples or evergreens. The lessons that nature would have us learn from these examples are that pruning should be such as to remove those shoots which are not in position to do the best ultimate service; that the removal of some branches is necessary to the best development of others; that thinning of the wood growth is necessary because more buds are formed and more twigs are started than can find light space for successful development; that the judicious removal of undesirable or poorly located shoots in their earliest stages of growth, is economy of labor and material (plant energy.)

Hence, remove undesirable wood, as far as possible, while it is small. This does not imply that large branches may not be taken off whenever found to be undesirable, but it does imply that such

removal means a greater loss of the plant's energy. This view of pruning and training calls for a full knowledge of the individual types of trees, their characteristic forms of growth and a comprehensive understanding of the requirements of economic plant culture.

If a young apple tree has been received from the nursery as a "switch" or "stick" one year old, there will be little pruning to be done at the time of planting out, save cutting back the top to correspond with the loss of root system made necessary by removal from



Fig. 22. A high head in Western Oregon.

the nursery row, and the trimming of wounded roots. Should the tree to be planted be of two or more years, as is too frequently recommended by nurserymen and dealers, then the whole top should be removed to such an extent as will correspond with the amount of roots cut away.

The writer recommends only one-year-old trees for general transplanting. A one-year-old tree is small; it does not suffer so severe a check upon removal from the nursery as an older tree. Less cutting back, relatively, is necessary at setting out. The wounds made

are smaller and accordingly heal over more readily, allowing less opportunity for attack by injurious fungi. As an evidence of the importance of this point, the size of the wounds, it may be stated that common observation throughout the Willamette valley during the past few years has pointed out the great loss that has occurred among plantations of prunes, in particular, through injudicious pruning at setting out time, or, possibly, to the lack of care in attending to the wounds made at the time of cutting back. At the time of setting out, usually late fall or early winter, the young



Fig. 23. Low heads with horizontal training.

prune tree is cut back to a mere stub, leaving, ordinarily, a raw wound from one-half to three-fourths of an inch in diameter exposed to the weather. The fall or winter planting of prune trees makes it almost imperative that the cutting back be done at the time, otherwise much damage may be done the plantation by winter winds swaying the trees back and forth, for the prune "switch," as commonly planted, exposes a considerable length of stem, from six to eight or more feet. If these wounds were painted at the time made with some tenacious material like white lead, in which has

been dissolved a little sulphate of copper, injury from exposure to the air would be prevented. These observations apply almost equally well to the apple, though the young apple tree, as a rule, is smaller and thus exposes less surface to the action of the wind.

The common practice in the more humid sections of the state is to head the tree at three to four feet from the ground, (See Fig. 22) while in the dryer portions the trees are headed as low as one foot, and on an average not more than two feet. This necessitates training the lowest branches to a somewhat erect position for at least



Fig. 24. Low heads with vertical training.

two years, otherwise they will interfere with the operations of tillage. See Figs. 23 and 24. In later years though these branches, while laden with fruit may almost touch the ground, no serious disadvantage will be felt during tillage, and the position of the fruit will be a decided gain in the work of spraying. See Fig. 25.

In fact all operations save tillage are benefitted by the formation of low heads. As the growers of Eastern Oregon remark; "We like to work on the ground floor, for it facilitates the work of picking and thinning;" while in sections where heavy winds prevail much less

loss of fruit occurs in orchards of low headed trees, and the trees themselves are of better form, thus requiring less attention and labor in pruning. See Fig. 26. It is true that in parts of Western Oregon and along the coast the fruit on low headed trees is often of indifferent color while that on trees of medium to high heads is of fair to high color. This fact makes it desirable that trees of late fall and winter varieties be headed or trained high in these sections while trees of summer and early fall varieties may be headed low if desired.



Fig. 25. This fruit is so located as to make spraying easy.

As to the manner in which the head may be formed there are several important points to keep in view. And first, perhaps as to whether a central leader shall be left, or all main branches trained to develop uniformly. The latter has been the common practice in later years, but recently some of the leading orchardists have been advocating a return to our earlier practices of leaving a central leader. The contention is that many trees are lost as a result of close or cramped forking at the origin of the head, while with a leader no such loss occurs. With a central leader there are so

many buds that remain latent that space sufficient for good branch unions is always present, whereas, the forced development of all buds at the top in the case of the young tree cut back, and the lack of ample forethought in the removal of the excess of branches, which, when young are not clearly evident as such, allows opportunity for too many faulty heads. As yet there are no well defined examples of superior young orchards grown with central leaders, but a comparison of our younger orchards with those planted years ago would seem to give considerable weight to the view that leaders



Fig. 26. Heavy winds little affect these low heads.

ought to be retained in general planting, though the specialist may adopt such style of head formation as he deems best suited to his taste, for in such cases ample attention will be given to the numerous minor matters that pertain to efficient pruning. Compare Figs. 3 and 27.

Then, after this question of form is settled there comes the question of branches or laterals. Not more than four, and usually three are quite enough for this purpose especially if a central leader is left. Too many branches make a bushy close top, while too few

would leave a top too open or ill shapen. In cases without a central leader the buds which are to form the chief branches of the head should be left not closer than eight inches apart. When the tree has grown to full size there will then be no more open space between them than is necessary to maintain a good strong union, a point that is too often overlooked in the formation of the heads of all kinds of fruit trees. See Figs. 28 and 29.

When the few topmost buds of the young tree are left to form the head they are usually so close together that in a few years the forks



Fig. 27. Good care but poor training.

of all are united and the result is a weakened union. There is not sufficient distance upon the main stem for the several branches, as they increase in size, to make a close union with it. At the end of the first season's growth the young branches that are destined to form the top should be cut back about one-half. From these stubs the next year two chief secondary branches should be allowed to form upon each. The following winter the young growth should again be cut back about one-half. The third and fourth years the tree should receive similar treatment. The fifth year, such branches

as interlace should be removed; irregular, diseased, and malformed shoots should be cut back or taken out as the case may demand. If the trees are planted upon deep, heavy, well-watered soil and continue to make excessive wood growth it may be necessary to give them a summer pruning which operation tends to check wood growth and induce the formation of fruit buds. In the warmer, dryer sections, and where the soil contains considerable sand, trees will begin to bear at five years or even earlier, but in those sections where the climate is cool and moist and the soil heavy and



Fig. 28. Young trees with leader removed.

deep, trees may show a disposition to devote all their effort to the production of wood until they are seven, eight or even nine years old. In such cases the check given by summer pruning is often desirable, though it may be a question as to whether trees ought not to be allowed to make their full growth before being forced into fruit production. Still, there is an advantage in hastening the time at which the trees are brought into bearing, and, if not allowed to overbear the first years of fruiting, they may complete their full growth without disadvantage to size or vigor, though the final

growth will be made more slowly than would be the case if the trees had not been hastened into bearing.

The need for future pruning of the orchard will be variable. Each variety has a characteristic habit of growth. The pruning necessary to make the growth conform to our chosen type will depend upon how far apart are the "type" and the "habit." If the grower at the outset has adopted the plan of studying the habits of the different varieties, and has pruned for the purpose of getting the best results with the natural form of the variety rather than for the



Fig. 29. A good example of care, also of poorly formed heads.

purpose of making all the trees conform to a common artificial ideal, then the work of pruning will be greatly simplified and reduced. The cutting back of excessive growths; the cutting out of interlacing, crossing, chafing, rubbing and diseased branches; and the shortening in, as an offset against winds, will be the chief points to keep in view in all subsequent pruning operations. In the past, too little attention has been given to the study of the individual habits of growth. Pruning has been indiscriminate. Not principles, but practices have prevailed in the direction of the work, un-

til we can find the trees of Western Oregon cast in the same mould as those of California or Southern and Eastern Oregon. Pears, apples, plums and cherries have been treated alike as to cutting back, form of head and style of branching! The practice followed with a species in a particular section, giving good results, has often been heralded as the ideal form for all fruit trees in, at least, the same cultural zone.

That such a course is most ill-advised can be readily seen if one will but observe the trees growing in any well-kept home orchard, and it may be said just here that the beginner in this work of growing an orchard would be well repaid by making a study of some of the best kept local orchards. Nothing can give one so good an idea of the traits of character of the different fruit trees as a study of the real plants as they develop under the hand of a good orchardist.

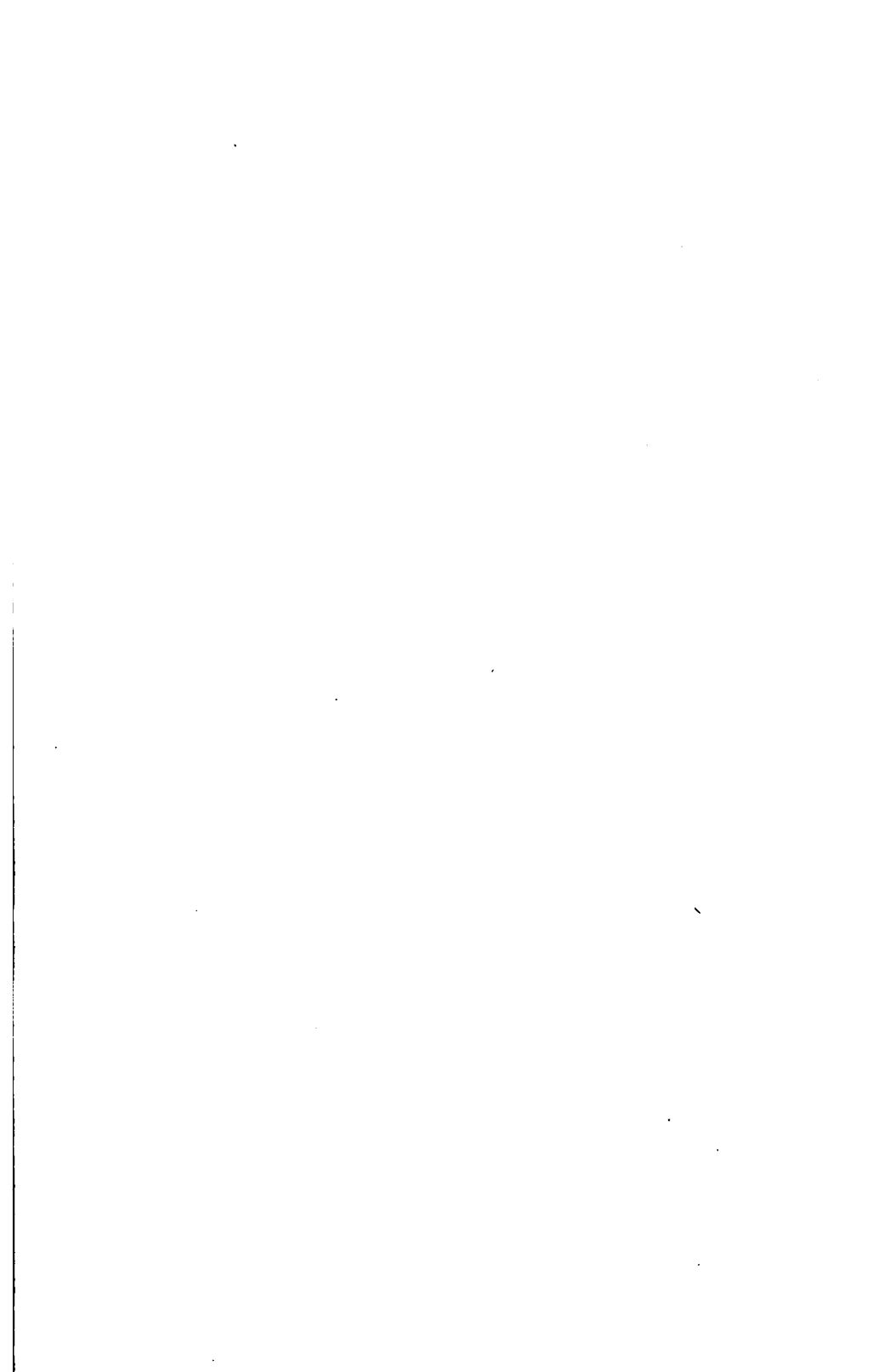
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Address JAMES WITHYCOMBE,
Director of Experiment Station, Corvallis, Oregon.



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Oregon Agricultural Experiment Station.

CORVALLIS, OREGON.

THE PERPETUATION OF PURE CULTURES FOR BUTTER STARTERS.

By E. F. PERNOT.

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Oregon Agricultural College Press



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THE PERPETUATION OF PURE CULTURES FOR BUTTER STARTERS.

BY E. F. PERNOT

The introduction and adoption of the cream separators has opened a new field of possibilities for controlling the flavor of butter, by the use of pure cultures of selected varieties of organisms, to such a degree of certainty that many of the leading dairies now use starters to assure a uniformity of flavor in their products. Some of the methods in vogue at present are crude, but as we progress new methods of perpetuating pure cultures will be introduced and modified to meet the requirements. For a starter most of the dairies procure a culture of organisms from firms who prepare them for the market. Upon receipt of the culture the content of the bottle is emptied into about two to three quarts of pasteurized skimmed milk. This is kept at a temperature of 60 to 70 degrees F. until about .4 of 1 per cent acidity is reached; it is then added to five gallons of pasteurized skim milk, and kept at a temperature of 60 to 70 degrees F. until an acidity of .3 to .4 per cent is reached, and then added to cream in an amount equalling from five to ten per cent; the cream is then ripened to an acid reaction of .5 to .6 per cent. To perpetuate, two quarts are taken of the starter and added to skimmed milk as before.

It is claimed that in about one week, starters handled in this way require being renewed by fresh cultures, but this may be obviated by the simple method herein described, and a pure culture can be perpetuated so long as reasonable care is exercised.

Before entering upon a description of a new method, it is well to consider some of the weak points in the old ones. If we continue replanting a culture in milk which is only pasteurized, it will eventually become so contaminated with undesirable germs as to overcome the flavor producing qualities of the starter, because pasteurized milk is but partially sterilized, and contains more or less spores and germs which have resisted the single pasteurizing temperature or even a higher one. They multiply and soon become as

numerous as those originally planted. In this way the starter loses its virtue and is but little or no better than milk soured in the open air. The first time that the starter is used, it is comparatively pure, but after that, every time it is added to fresh pasteurized milk more foreign germs develop in it and prevent the desirable ones from exerting their influence until finally the starter becomes useless. In the preparation of anti-toxin, vaccine, and serum; in fact all bacteriological work, the strictest precautions are exercised to prevent contamination or mixtures of germs, lest the products become valueless. Most of the dairy work is of a bacteriological nature and if the highest results are to be obtained by the use of pure cultures, then at least some bacteriological methods must be employed. The following is a simple and effective way of perpetuating pure cultures for starters and is within the capabilities of any modern dairyman.

Take twelve or more one pint milk bottles, wash thoroughly with hot water and soap, steam them out to remove all traces of the soap, then fill half full with fresh milk, skimmed with a separator. Take some cotton batting and plug the necks of the bottles with good substantial plugs, neither too loosely nor too tightly. The plug should reach at least one and one-half inches below and one-half inch above the top of the bottle neck. Never wet the cotton or it will become useless.

Through the center of one of these plugs, pass a glass tube sufficiently long to reach to within one inch of the bottom of the bottle and extend an inch or more above the cotton plug. The lower end of this tube is partly closed so as to hold milk in it by capillarity. The upper end is filled with cotton for one inch in length and then the rubber bulb from a medium dropper is slipped on the tube. (See Fig. 1). The cotton in the tube is to prevent any germs from entering the tube although they may find their way into the bulb.

A well made wooden box with a closely fitting cover is then provided and connected with a steam pipe and acts as a steam chest; the bottles are then placed in the box, lid replaced and steam turned on. To ascertain the temperature, place another bottle in the box, fill it with water or milk and place a thermometer in it. The temperature of the milk may thus be obtained and should be raised to 180 degrees F. or higher, and maintain this heat for twenty minutes. The cover is then taken off the box and the cotton plugs will dry



FIGURE 1

immediately. This operation should be repeated three times, allowing twenty-four hours to elapse between heatings; the milk will then be sterile and in an ideal condition for germs to grow in when planted. Milk so treated will remain sterile for an indefinite time.

Another means of sterilizing the milk intermittently, is to use a steam cooker or Arnold steam sterilizer. Either of these may be used to good advantage in dairies where steam is not available, as they may be placed on a stove and require no further attention other than to note the time that the bottles remain in them, which ought not to be more than ten minutes after the milk has acquired the temperature of the sterilizer, which is 212 degrees F. A fixed time cannot be given here for the bottles to remain in the sterilizer as it will vary with the amount of heat applied. Still another method is to sterilize the milk in one operation by the use of steam under a pressure of ten pounds, which gives a temperature of 240 degrees F. It should be kept at this heat for from five to ten minutes, but the milk is not as suitable for culture purposes as when sterilized at a lower temperature, besides, an autoclave or steam chest capable of withstanding such a pressure is required and is seldom found in a dairy. While sterilizing the milk bottle with the pipette in it, the lower end of the pipette should be raised out of the milk to avoid pressure sending the milk up the tube and wetting cotton in the upper end or filling the bulb. After sterilizing the milk of course, the pipette must be lowered into it again.

The next step is to procure a suitable culture. If bought from a dealer, the cork must be carefully removed without allowing any particles of wax to fall into the bottle; the neck is then passed through the flame of an alcohol lamp to sterilize it, and contents of the bottle emptied into the bottle containing the pipette. To do this properly, twist the cotton plug to loosen it, draw it out gently and just high enough to insure its not touching the other bottle while it is being emptied; replace it immediately and shake the bottle slightly to mix the culture with the milk. After twenty-four hours this gives the first starter. To perpetuate it, withdraw the cotton plug from a sterile bottle of milk and at the same time withdraw the cotton plug and pipette together and transfer them to the other bottle quickly and absolutely without touching them to anything. When in place the pipette bulb is squeezed, which empties the milk which it has carried from the first bottle into the fresh milk, thus inoculating a fresh supply of milk with the organisms

desired. The contents of the bottle which had the pipette will then be ready with a pure culture, to be emptied into the required amounts of pasteurized milk or cream as it is customarily done.

There are a few points about this method which must be rigidly observed to insure success, otherwise it is much more simple than it appears in print.

The inoculation of one bottle from another must be quickly done and *positively* without touching the pipette or plug with anything else. Particles of cotton or dust *must not* fall into the bottles. The milk *must* be sterile before inoculating. Cultures of reliable purity must be used for the first inoculation. As fresh milk as possible should be used for culture media lest the products of bacteria which had acted upon older milk should act as enzymes and cause disturbances later. Very fresh milk should be used for culture media, not only because it contains less germs, but less germ products which may have a peptonizing action. Fresh milk also contains its full food value for germ cultures. The mixed skim milk from patrons of a dairy will not give such good results, because it is much more difficult to sterilize and is robbed of some of its normal constituents.

During the dairy short course last winter, this method was carried on by the students with good success. Plate tests were made at regular intervals and the starters were found to maintain their original pure cultures throughout the term. The butter which was made with the use of these cultures, was carefully scored by Professor Kent, of the dairy department. The data relative to the several churnings is given in the following table:

Churnings of February 18, 1904.
Each consisting of 17 pounds of Cream containing 27 per cent Fat.

Culture used.	Acidity.	Churn Temp.	Time of Churning.	Per cent Fat in Buttermilk.	Flavor Score.	
	Per cent.	Degrees	Minutes.		At 1 week.	At 3 weeks.
Check.	.60	59	16	.3	40	35
A	.69	59	25	.2	42	37
B	.57	59	23	.2	41	35
C	.59	59	30	.2	41	35
D	.68	59	23	.2	41½	41
E	.58	59	19	.3	40½	41
F	.57	59	27	.15	39	40

Churnings of February 20.
Each consisting of 19 pounds of Cream containing 27 per cent Fat.

A	.60	58	23	.2	41	33
B	.57	58	23	.3	40	33
C	.60	58	27	.2	42	35
D	.61	58	24	.2	43	41
E	.60	58	23	.2	40	41
F	.60	58	30	.2	41	40

Churnings of February 23.
Each consisting of 19 pounds of Cream containing 25 per cent Fat.

Check.	.66	62	14	.4	40	40
A	.70	62	15	.5	41	38
B	.69	62	15	.4	41½	40
C	.70	62	16	.4	41½	40
D	.69	62	17	.5	42½	39
E	.67	62	12	.5	40	39
F	.70	62	18	.6	41½	39

Churnings of February 25.
Each consisting of 18 pounds of Cream containing 28 per cent Fat.

Check.	.68	60	15	.4	40½	32
A	.64	60	18	.4	39	32
B	.66	60	21	.4	41	34
C	.63	60	30	.2	42	39
D	.67	60	23	.4	41½	33
E	.61	60	24	.2	41	35
F	.66	60	28	.3	40	36

45 is considered a perfect score for flavor in this table. As indicated by the table the several lots of butter were scored at one week and again at three weeks after making. It is interesting to note that in two cases there was a slight improvement in flavor at the time of the second scoring. The low scores for the second scoring of the churning of Feb. 25 are probably due to the samples being examined when four, instead of three weeks old as in the other cases.

The samples were kept in a refrigeration box but without ice, the room temperatures varying from 50 to 70 degrees F.

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DEPARTMENT OF AGRICULTURE.

Oregon Agricultural Experiment Station.

CORVALLIS, OREGON.



Fig. II. Compact Meaty Type.

Poultry Under Confinement.

By JAMES WITHYCOMBE.

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1905

**Oregon Agricultural College Press
Corvallis, Oregon**

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POULTRY UNDER CONFINEMENT.

JAMES WITHYCOMBE.

The data submitted in this bulletin are for the purpose of illustrating the financial returns from a small flock of poultry kept under confinement to show the percentage of eggs hatched, chickens grown to marketable age and the proportion of sexes.

There seems to be little danger from an over supply of poultry and eggs in the principal markets of this state. Large numbers of eggs are annually shipped in from outside points which indicates that the home supply is not equal to the demand. Thus a stable market at satisfactory prices is assured to our poultry growers. Dressed and live poultry are always in demand, hence the poultry industry as a whole has a bright financial future.

There is scarcely a large poultry farm in the state, but there are a number of small ones that are successfully conducted. It is doubtful if there is a single agricultural industry that presents a better field for profitable endeavor than does poultry farming. The price of success is eternal vigilance, especially so in the warfare of exterminating parasitic pests. This feature of the industry on the ordinary farm is oftentimes woefully neglected. Little if any attention is bestowed on the cleanliness of the hen-house or an effort made to destroy the mites (*Dermanyssus gallinae*). This pest is easily responsible for greater financial losses in poultry than any single disease, or perhaps more than all of the common ailments of poultry combined.

The breed represented in the test herein recorded was White Plymouth Rocks—comprising twenty-four pullets, three one-year-old hens and two two-year-old hens and a two-year-old cock.

While no account of the laying of individual hens was kept, it was very evident that some of the hens were more persistent layers than others. Form and function seem to go hand in hand in the laying hen, for, as a rule, the rather long, slender bodied hens were better layers than the more compact, meaty type. The former is illustrated in Fig. 1 and the latter in Fig. 2. There is evidently an important field for work in the breeding up of a class of hens that are heavy egg producers. This line of work has been systematically conducted at the Maine Station for several years, with the result that a Barred Plymouth Rock hen has been bred which laid two-hundred and fifty-one eggs in one year.

A very generous system of feeding was employed. In the morning a hot mash consisting of ground wheat, oats and barley, with cracklings or meat meal was fed, and in the evening they were fed all the whole wheat they would pick up. Granulated bone and crushed oyster shells were kept within their reach at all times, and clean drinking water was supplied once and oftentimes twice daily. They had the run of a little less than one-half acre, with plenty of shed room and shade trees. The hen-house was well lighted, ventilated and kept reasonably clean. The roosts were treated with kerosene about once a month, which seemed to effectually control the mite pest. There



Fig. 1. The Laying Type.

was no attempt in the management of the flock to exceed common practical treatment. The hens employed for hatching were confined in a separate building, and those not wanted for this purpose when desirous of sitting were placed in a comfortable coop for a few days and then turned with the flock again.

Each evening the eggs were carefully collected. The daily record is given to illustrate the variations from day to day, and the prices quoted were taken from the Daily Oregonian each Saturday.

Date.	No. of Eggs.	Per Dozen.	Value.	Date.	No. of Eggs.	Per Dozen.	Value.	Date.	No. of Eggs.	Per Dozen.	Value.
Jan. 1	5			Feb. 21	9			April 14	18		
2	8	.30		22	14			15	18		
	13		.32½	23	16			16	12	.18	
3	5			24	18				91		1.36
4	7			25	11				17	16	
5	6			26	14	.21		18	17		
6	6			27	14		1.50	19	14		
7	7				91			20	15		
8	7			28	18			21	18		
9	4	.27½		29	14			22	18		
	42		.96	Mar. 1	9			23	18	.19	
10	9			2	13				100		1.56
11	5			3	9				24	16	
12	8			4	12	.19		25	12		
13	8			5	12		1.29½	26	15		
14	8				82			27	12		
15	6			6	11			28	16		
16	6	.27		7	10			29	13	.18½	
	50		1.12½	8	11			30	11		1.46
17	6			9	12				95		
18	8			10	12			May 1	10		
19	6			11	8	.15½		2	10		
20	6			12	10		.95½	3	11		
21	6				74			4	8		
22	5			13	11			5	11		
23	10	.28		14	12			6	11	.18	
	47		1.09½	15	11			7	16		1.15
24	9			16	12				77		
25	18			17	12			8	9		
26	9			18	14	.16½	1.15	9	12		
27	9			19	12			10	12		
28	10				84			11	10		
29	10	.27½		20	7			12	12		
30	10		1.60	21	11			13	10	.18	
	70			22	10			14	16		1.21
Feb. 31	9			23	15				81		
1	12			24	8				15	13	
2	10			25	13	.17½		16	10		
3	12			26	10		1.07½	17	13		
4	10				74			18	11		
5	10	.26		27	13			19	13		
6	10		1.56	28	11			20	9	.18	
	78			29	7			21	9		1.17
7	8			30	10				78		
8	10			31	8				22	11	
9	14			April 1	11	.18			23	10	
10	12			2	11		1.06		24	9	
11	8				71				25	13	
12	11	.27½		3	9				26	11	
13	14		1.76	4	13				27	12	.18
	77			5	11				28	9	
14	9			6	12				75		1.12
15	15			7	8				29	9	
16	12			8	13	.18			30	8	
17	12			9	14		1.20	June 1	10		
18	14				80			2	11		
19	13			10	14			3	12		
20	11	.26		11	11			4	11	.17½	
	86		1.86	12	14				10		
				13	14				71		1.03

Date.	No. of Eggs.	Per Dozen.	Value.	Date.	No. of Eggs.	Per Dozen.	Value.	Date.	No. of Eggs.	Per Dozen.	Value.
June 5	10			July 28	6			Sept. 18	6		
6	15			29	8			19	9		
7	12			30	8	.21		20	8		
8	12				54		.94	21	9		
9	12			31	6			22	9		
10	12			Aug. 1	10			23	6		
11	18	.18½		2	7			24	10	.25	
	86		1.82	3	8				57		1.18½
12	10			4	9			25	10		
13	9			5	8			26	8		
14	11			6	8	.21		27	11		
15	10				57		.99½	28	9		
16	11			7	4			29	10		
17	10	.20		8	11			30	11	.25	
18	14			9	10			Oct. 1	15		
	75		1.25	10	5				74		1.54
19	12			11	7			2	5		
20	11			12	6	.21		3	11		
21	12			13	6			4	11		
22	14				49		.85½	5	10		
23	9			14	9			6	13		
24	9	.19%		15	8			7	9	.25	
25	10			16	7			8	11		1.45½
	77		1.25	17	8				70		
26	10			18	4			9	11		
27	14			19	7	.21		10	6		
28	11			20	8			11	9		
29	12				51		.89	12	5		
30	7			21	9			13	8		
July 1	12	.20		22	8			14	9	.27	
2	11			23	8			15	10		1.30
	77		1.28	24	7				58		
3	8			25	8			16	8		
4	11			26	10	.23		17	8		
5	9			27	12			18	6		
6	9				62		1.18½	19	9		
7	7			28	9			20	8		
8	10	.20		29	11			21	9		
9	8			30	9			22	18	.28	
	62		1.08	31	7				61		1.42
10	10			Sept. 1	6			23	8		
11	10			2	5	.25		24	10		
12	8			3	5			25	12		
13	9				58		1.10	26	10		
14	9			4	8			27	11		
15	10	.20		5	6			28	18	.28	
16	10			6	5			29	12		
	66		1.10	7	4				76		1.77
17	8			8	4			30	4		
18	10			9	4			31	10		
19	6			10	4	.24		1	14		
20	6				35		.70	2	9		
21	7			11	4			3	10		
22	6			12	4			4	11		
23	6	.21		13	5			5	10	.28	
	49		.85½	14	4				68		1.58
24	7			15	4			6	12		
25	8			16	4			7	12		
26	8			17	3	.25		8	16		
27	9			28	28		.58	9	10		

Date.	No. of Eggs.	Per Dozen.	Value.	Date.	No. of Eggs.	Per Dozen.	Value.	Date.	No. of Eggs.	Per Dozen.	Value.
Nov. 10	10			Nov. 27	12			Dec. 16	8		
11	18			28	11			17	7	.32½	
12	17	.30½		29	11				59		1.59½
	90		2.28½	30	14						
				Dec. 1	9						
13	10			2	18			18	7		
14	9			3	6	.32½		19	6		
15	9				76		2.05½	20	5		
16	11							21	5		
17	6			4	18			22	7		
18	16			5	7			23	5		
19	12	.31½		6	11			24	6	.32½	
	78		1.91½	7	8				41		1.11
				8	10						
20	12			9	8			25	5		
21	9			10	8	.32½		26	5		
22	11				65		1.76	27	4		
23	9							28	4		
24	9			11	9			29	4		
25	12			12	8			30	1		
26	10	.31½		13	11			31	3	.31	
	72		1.89	14	8				26		.67
				15	8						

Total number of eggs.....3529
 Total receipts for eggs.....\$57.58
 Average price per dozen.....23½ cents

Financial Statement.

3529 eggs.....	\$57.58
45 pullets and cockerels at 50 cents each	24.00
	\$91.58

EXPENDITURES.

100 eggs for setting at 23½ cents per dozen	\$ 1.95
2 dozen eggs fed to chickens	.47
70 lbs. granulated bone at 2 cents per lb.	1.40
7 lbs. diamond grit.....	.15
100 lbs. ground oyster shells and freight	1.40
75 lbs. cracklings at 1 cent per lb.	.75
50 lbs. meat meal and freight.....	2.55
10 lbs. dried blood.....	.60
2307 lbs. wheat at 1½ cents per lb.	34.61
1001 lbs. wheat chop at 1½ cents per lb.	12.52
84 lbs. oat chop at 1½ cents per lb.	1.05
84 lbs. barley at 1½ cents per lb.	1.05
400 lbs. middlings at 1 cent per lb.	4.00
2 quarts of coal oil.....	.12
Loss, 4 hens at 50 cents each	2.00
Net return.....	\$64.62
	\$26.96

Date of Hatching.

Date of Setting.	No. of Eggs	Date of Hatching.	No. Chicks Hatched.
1904			
January 11.....	18	February 2.....	8
17.....	13	8.....	10
March 4.....	15	March 26.....	11
8.....	13	30.....	7
12.....	15	April 2.....	8
26.....	16	15.....	16
*April 1.....	15	22.....	15

*Eggs secured from other yards.

Total number of eggs set 100. Number of chicks hatched 75. Percentage of hatch 75. Number of chicks grown to marketable age 48. Percentage of total number hatched 64. Number of pullets 27. Number of cockerels 21. Percentage of pullets 56. Percentage of cockerels 44.

The low percentage of hatch of home produced eggs was evidently due to too many hens to one male.

Predatory animals and birds were responsible for greater losses of young chicks than from natural causes.

Four hens died during the year, one Jan. 27, from dysentery; one Nov. 20, cerebral ailment; two Dec. 25—one from apoplexy and the other from pneumonia. Thus making a loss of 13 per cent. This loss was probably augmented on account of the birds being excessively fat.

The profits from the flock would certainly have been greater had the older hens been disposed of early in the Fall, or about the time that the early hatched pullets began to lay.

The first pullet began laying July 10, when she was five months and eight days old. The second Aug. 21. About this time several began to lay.

Management of the Young Chicks.—About twenty-four hours after the chickens are hatched they should be removed with the hen to a clean coop, one that has been thoroughly disinfected, so that every form of parasitic life is destroyed. The little chicks should be fed a small amount of hard boiled eggs for the first two days, then they may receive bread crumbs, or cracked wheat. Clean water should be supplied in a shallow vessel. It is a good plan to cover the floor of the coop with sand, by so doing the young chicks in picking up their food will get more or less sand which will prove beneficial. After the chicks are a week old they will enjoy a moderately soft mash of ground wheat to which small amounts of sand and bone meal have been added. It is essential that young chicks receive more of the mineral nutrients than exist in ordinary foods. The organic forms of phosphate as found in ground bones will prove more efficient than the rock phosphate. Experiments have demonstrated that it is not advisable to mix ground oyster shells with the food of young chicks, although it is a good plan to permit them to partake of it at their own volition.

Early hatched chicks will prove less troublesome to rear than late hatched. They escape in a measure the torments of parasites that are usually so common during the warm season, and the pullets will lay well in the Fall when eggs are a good price.

Hens having free range and proper food will usually give much better results with their chickens than hens which are confined in yards.

These suggestions are simply intended for the management of small flocks, as the modern and most desirable method of handling chickens on a commercial scale is with the incubator and brooder.

Failures with poultry are generally due to improper rations, bad sanitation, over-crowding and parasites. Keep their roosting places clean, light and airy and supply the poultry with properly balanced rations, with mineral matter, grit and dust boxes and they will yield a handsome revenue for capital invested.

Conclusions.—This test demonstrates conclusively that a small flock of poultry may be profitably kept under confinement.

That early hatched pullets are more profitable than late hatched ones.

Although the cost of feeding this flock was abnormally high, it yielded a net profit of 180 per cent on the original investment of fifteen dollars.

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Bulletin No. 85.

March, 1905.

DEPARTMENT OF AGRICULTURE.

Oregon Agricultural Experiment Station.

CORVALLIS, OREGON.

Digestibility of Vetch Hay and Corn Silage.

By JAMES WITHYCOMBE AND A. L. KNISELY.

THE BULLETINS OF THIS STATION ARE SENT FREE TO ALL RESIDENTS
OF OREGON WHO REQUEST THEM.

1905

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Corvallis, Oregon

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BULLETIN NO. 85.

DIGESTIBILITY OF VETCH HAY AND CORN SILAGE.

JAMES WITHYCOMBE AND A. L. KNIBELY.

SUMMARY.

Four feeding experiments were conducted with cattle from the Station herd. Each experiment extended over a period of seven days.

Two of the experiments were conducted with vetch hay (*Vicia sativa*) and two with corn silage.

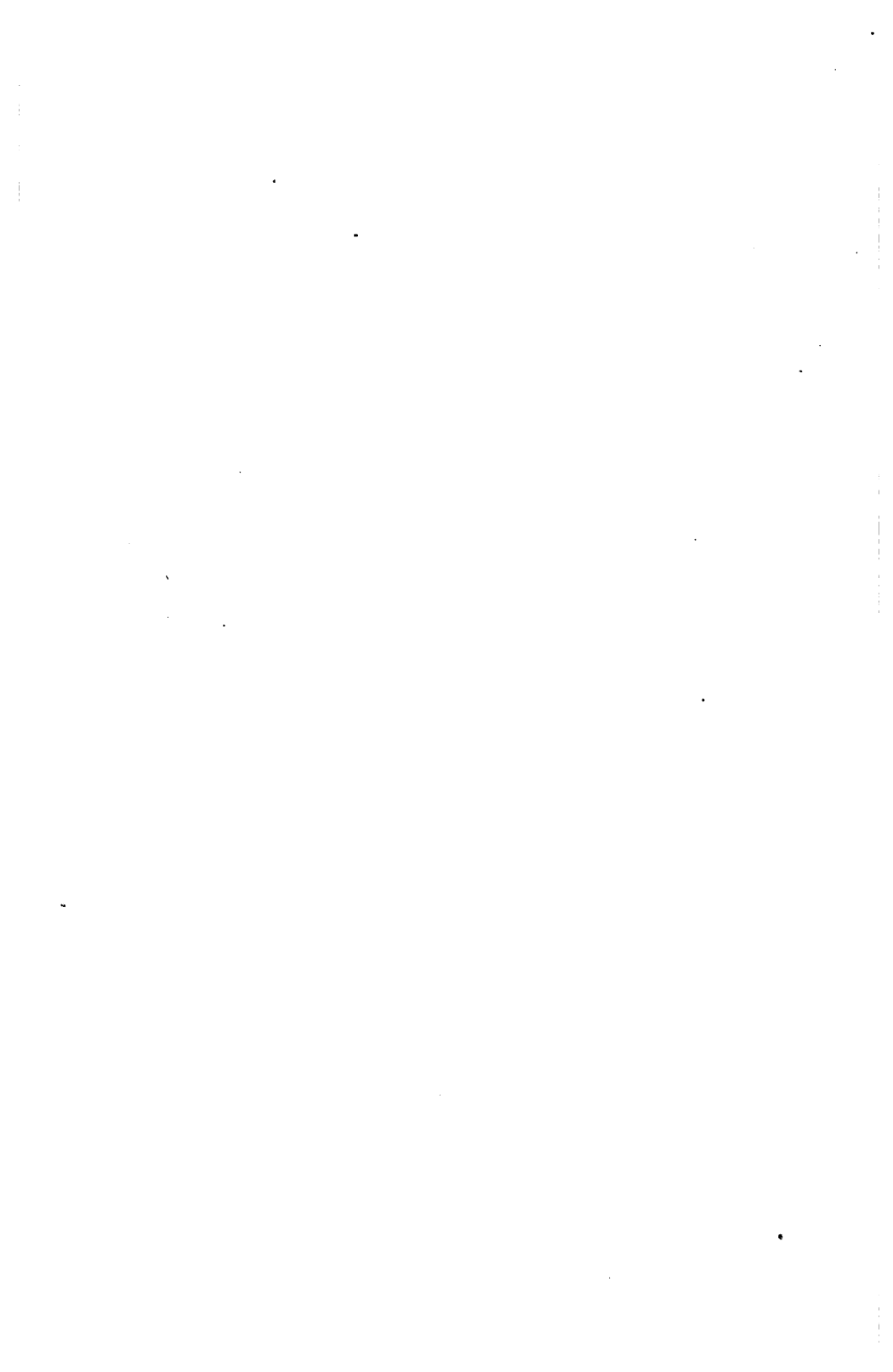
The average results of these experiments are as follows:

DIGESTIBILITY OF VETCH HAY (*Vicia sativa*).

	Dry substance	Organic Matter	Ash	Protein	Crude Fiber	Nitrogen Free Extract	Ether Extract or Fat
Per cent digested -	66.05	67.35	52.23	69.91	57.56	71.59	71.21

DIGESTIBILITY OF CORN SILAGE.

	Dry substance	Organic Matter	Ash	Protein	Crude Fiber	Nitrogen Free Extract	Ether Extract or Fat
Per cent digested -	73.08	75.09	47.98	55.03	75.34	75.65	89.91



INTRODUCTION.

The common vetch (*Vicia sativa*) is becoming one of the most popular forage plants grown in Western Oregon. There are perhaps a thousand tons of vetch hay produced in this section now to one grown eight or ten years ago. This plant is hardy, enjoys a wide range of growth and is rich in protein. Its palatability is also a feature as all classes of stock are exceedingly fond of it, either in the form of hay or green forage.

When the virtues of this plant are more generally known to agriculturists the area of its culture will be appreciably extended. In addition to its value as a stock food, it is evidently an active nitrogen gatherer. Its roots are usually abundantly supplied with nodules and the generally increased crop production following its growth is good evidence of its value as a soil improver.

There seems to be a peculiarly wide variation in the protein content of individual plant. An investigation conducted by the Chemist of the Station in 1904 indicated that this variation in the water-free plant ranged from 12.19 per cent to 23.31 per cent total protein. Thus it would seem that this plant presents a very important field of work for the development of a race of vetch rich in protein.

The following table represents the results of analyses of portions of individual vetch plants at the proper stage of maturity for hay.

Per cent of Protein in Water-free Material.

No.	Per Cent.	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.
5	12.19	9	16.38	77	17.37	24	18.13	36	18.75	22	19.63
2	14.69	12	16.38	66	17.37	1	18.13	61	18.88	18	19.69
64	14.94	63	16.38	30	17.44	67	18.19	40	18.94	70	20.00
42	15.00	54	16.63	33	17.44	69	18.19	3	18.99	29	20.06
20	15.29	78	16.75	46	17.56	16	18.25	53	19.06	21	20.19
72	15.38	56	16.81	65	17.56	17	18.25	6	19.13	23	20.25
51	15.69	74	16.81	43	17.63	19	18.25	18	19.13	32	20.44
75	15.81	10	17.00	58	17.63	50	18.31	44	19.13	47	20.50
7	15.94	79	17.00	14	17.75	49	18.38	39	19.19	34	20.75
35	15.94	41	17.19	76	17.75	78	18.38	52	19.19	48	20.75
62	16.00	55	17.19	15	18.00	38	18.50	80	19.44	28	21.13
31	16.06	60	17.25	26	18.00	45	18.55	4	19.50	27	21.69
8	16.25	37	17.37	71	18.00	68	18.69	11	19.63	59	22.13
									25	23.31	

Seed from each plant showing a protein content of 20 per cent and above have been planted. A portion of individual plants of each generation will be analyzed and seed from those indicating a high protein content will be utilized for propagation. In this way it is hoped that in time a type of vetch can be produced having a large percentage of protein.

In view of the fact that vetch hay is destined to become an important factor in supplying nutrients to domestic live stock, the Station deemed it advisable to secure data as to its digestive coefficients.

The corn silage used in the test was steamed, although imperfectly done. This test was made with the express purpose of determining whether the steaming of silage decreased the percentage of its digestibility. Comparisons made with a number of other tests recorded, indicated that the heating of the silage did not have this effect, as its digestibility was found to be above the average given for corn silage.

The tests were made under as normal conditions as could be obtained. The cattle possessed a good constitutional vigor and the selection of the individuals was made to represent the average conditions usually found in herds. Golden Alice is a matured pure-bred Jersey cow well advanced in the period of lactation. Gladys A. is a two-year-old pure-bred Jersey heifer and was well advanced in the period of gestation at the time of the test. The other heifer, a yearling Shorthorn-Jersey cross, was not pregnant. Thus the three animals fairly represented average conditions found in dairy herds.

ANALYTICAL DATA AND RESULTS.

After the preliminary feeding each of the digestion experiments was continued for seven days. During the continuation of the feeding tests the cows were carefully watched day and night. A careful account was kept of the hay and water or corn silage and water consumed and of the feces produced. Composite samples of the hay and corn silage were taken daily and moisture determinations made each day. The feces were caught and weighed as soon as produced and samples placed in air-tight Mason jars. Composite samples of the feces were made each day during the digestion experiments. Determinations of moisture and total nitrogen in the feces were made daily.

EXPERIMENT I.—Digestibility of Vetch Hay.—Golden Alice at the beginning of the test weighed 970 pounds while at the end of the experiment she weighed 945 pounds, thus sustaining a loss of 25 pounds. During the feeding test she shrunk very little in milk production. A composite sample of the milk obtained during the feeding experiment contained 5.70 per cent of fat which was a trifle below the normal per cent.

Golden Alice.		Vetch Hay consumed. Lbs.	Water drunk. Lbs.	Feces produced. Lbs.	Milk produced. Lbs.
6 P. M. Nov. 20 to 6 P. M. Nov. 21	-----	20	20	21.06	8.00
" 21	" 22	22	20	22.00	8.00
" 22	" 23	20	38	30.00	10.50
" 23	" 24	20	80	26.25	7.00
" 24	" 25	20	90	34.50	8.00
" 25	" 26	20	84	28.56	8.00
" 26	" 27	20	42	28.75	7.00

EXPERIMENT II.—Digestibility of Vetch Hay.—Gladys A at the beginning of the feeding experiment weighed 740 pounds and at the end of the experiment she weighed 770 pounds, making a gain of 30 pounds during the seven days. The cow was dry during the experimental period.

Gladys A.		Vetch Hay consumed. Lbs.	Water drunk. Lbs.	Feces produced. Lbs.
6 P. M. Nov. 20 to 6 P. M. Nov. 21	-----	20	20	20.12
" 21	" 22	21	20	23.75
" 22	" 23	19	40	27.50
" 23	" 24	18	60	27.50
" 24	" 25	20	84	27.50
" 25	" 26	20	76	28.50
" 26	" 27	20	58	33.00

EXPERIMENT III.—Digestibility of Corn Silage.—Golden Alice at the beginning of the experiment weighed 940 pounds, at the end of the experiment she weighed 910 pounds, thus sustaining a loss of 30 pounds in seven days. During the feeding test she gave very nearly her average amount of milk. A composite sample of the milk extending over the experimental period contained 5.70 per cent of fat which was a trifle below the normal per cent.

Golden Alice.	Corn Silage consumed. Lbs.	Water drunk. Lbs.	Feces produced. Lbs.	Milk produced. Lbs.
6 P. M. Dec. 2 to 6 P. M. Dec. 3.....	88	0.00	26.75	7.00
" 3 " " 4.....	82	0.00	18.25	8.00
" 4 " " 5.....	66	0.00	20.12	7.00
" 5 " " 6.....	55	0.00	20.25	6.00
" 6 " " 7.....	72	0.00	18.25	7.00
" 7 " " 8.....	65	0.00	15.50	7.00
" 8 " " 9.....	45	0.00	20.88	8.00

EXPERIMENT IV.—Digestibility of Corn Silage.—Cross-bred heifer at the beginning of the feeding experiment weighed 530 pounds. At the end of the experimental period she weighed 530 pounds, having undergone no change in weight. The heifer was dry during the feeding test.

Cross-bred heifer.	Corn Silage consumed. Lbs.	Water drunk. Lbs.	Feces produced. Lbs.
6 P. M. Dec. 2 to 6 P. M. Dec. 3.....	87	0.00	18.25
" 3 " " 4.....	62	0.00	14.88
" 4 " " 5.....	60	0.00	18.88
" 5 " " 6.....	50	0.00	21.75
" 6 " " 7.....	72	0.00	22.25
" 7 " " 8.....	70	0.00	23.00
" 8 " " 9.....	42	0.00	19.12

In each of the feeding tests with corn silage the cows drank no water. It was offered them daily but they refused to drink.

EXPERIMENT II.—Gladys A.—The analytical data obtained are as follows:

EXPERIMENT III.—Golden Alice.—The analytical data obtained are as follows:

[illegible]

		Corn silage consumed	Moisture in corn silage	Water-free corn silage consumed	Water contained in silage consumed	Water consumed in silage and drink	Fresh feces produced	Weight feces when dry	Moisture in feces	Nitrogen in fresh feces	Nitrogen in fresh feces ³
	Lbs	Perc t	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Perc t	Perc t	Lbs
6 P. M.	Dec. 2 to 6 P. M.	87	82.28	6.56	90.44	30.44	18.25	2.780	85.04	.324	.0391
" "	" " "	62	83.45	10.26	51.74	51.74	14.38	2.082	85.52	.314	.0482
" "	" " "	4	81.61	11.03	48.97	48.97	18.88	2.681	85.80	.360	.0661
" "	" " "	5	83.43	8.28	41.72	41.72	21.75	2.848	86.93	.296	.0644
" "	" " "	7	72	84.20	11.68	60.62	32.25	2.821	87.32	.319	.0710
" "	" " "	8	83.14	11.80	58.20	58.20	23.00	2.859	87.57	.318	.0781
" "	" " "	8	42	82.75	7.24	34.76	19.12	2.838	87.77	.309	.0610

Analysis of	Fresh material						Water-free material					
	Water	Ash	Protein	Crude fiber	Nitrogen free extract	Fat	Ash	Protein	Crude fiber	Nitrogen free extract	Fat	
	Per ct	Per ct	Per ct	Per ct	Per ct	Per ct	Per ct	Per ct	Per ct	Per ct	Per ct	Per ct
Composite vetch hay.....	18.24	7.01	12.71	21.59	37.86	2.59	8.58	15.54	26.40	46.31	3.17	
Composite corn silage.....	88.02	1.27	1.62	4.02	8.94	1.28	7.49	8.92	28.69	52.66	7.24	
Composite sample of feces from Golden Alice when fed vetch hay.....	79.49	2.37	2.87	7.06	7.67	0.52	11.54	13.99	34.52	37.42	2.53	
Composite sample of feces from Gladys A when fed vetch hay.....	80.94	2.39	2.57	5.96	7.61	0.54	12.56	13.48	31.20	39.92	2.84	
Composite sample of feces from Golden Alice when fed corn silage.....	84.15	2.29	2.34	3.32	7.48	0.42	14.46	14.76	20.91	47.20	2.67	
Composite sample of feces from cross-bred heifer when fed corn silage.....	86.82	1.85	1.94	2.88	6.15	0.36	14.06	14.72	21.83	46.70	2.70	

Determinations of total nitrogen were made daily in fresh samples of the feces. Later the total nitrogen was determined a second time in the feces after drying with the following results calculated to water-free feces:

	Protein (N x 6.25)
Golden Alice—vetch hay feces in fresh sample.....	13.99 per cent
in dried sample.....	12.00 per cent
Gladys A.—vetch hay feces in fresh sample.....	18.48 per cent
in dried sample.....	12.98 per cent
Golden Alice—corn silage feces in fresh sample.....	14.78 per cent
in dried sample.....	13.00 per cent
Cross-bred heifer—corn silage feces in fresh sample.....	14.72 per cent
in dried sample.....	13.16 per cent

From these figures we see that if the feces are dried before the determination of nitrogen is made that the results will be erroneous and misleading. It is necessary to make nitrogen determinations in the fresh feces as soon as they come to the laboratory in order to obtain correct results.

The record kept in each of the four digestion experiments extended over seven days. The digestibility of the vetch hay and corn silage was arrived at by comparing what was eaten during the first six days with what was excreted during the last six days.

Experiment I (Concluded).—Golden Alice fed vetch hay.

	Dry substance	Organic matter	Ash	Protein	Crude fiber	Nitrogen-free extract	Ether extract or fat
	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs
Golden Alice consumed from 6 P. M. Nov. 20 to 6 P. M. Nov. 26, 122 lbs. vetch hay which contained	99.71	91.16	8.55	15.51	26.34	46.19	8.16
Golden Alice produced from 6 P. M. Nov. 21 to 6 P. M. Nov. 27, 170.06 lbs. feces which contained	34.776	30.746	4.03	4.88	12.04	13.04	0.88
Digested	64.934	60.414	4.52	10.63	14.30	33.15	2.28
Per cent undigested	34.88	33.73	47.13	31.46	45.71	28.23	27.85
Per cent digested	65.12	66.27	52.87	68.54	54.29	71.77	72.15

Experiment II (Concluded).—Gladys A fed vetch hay.

	Dry substance	Organic matter	Ash	Protein	Crude fiber	Nitrogen-free extract	Ether extract or fat
	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs
Gladys A consumed from 6 P. M. Nov. 20 to 6 P. M. Nov. 26, 118 lbs. vetch hay which contained	96.46	88.19	8.27	15.00	25.48	44.67	3.6
Gladys A produced from 6 P. M. Nov. 21 to 6 P. M. Nov. 27, 187.75 lbs. feces which contained	31.855	27.845	4.01	4.31	9.98	12.77	.91
Digested	64.605	60.345	4.26	10.69	15.50	31.90	2.15
Per cent undigested	33.02	31.67	48.49	28.73	39.17	28.59	29.74
Per cent digested	66.98	68.43	51.58	71.27	60.83	71.41	70.26

The results derived from experiments I and II, indicating the digestibility of the food nutrients of vetch hay, are as follows:

	Dry substance	Organic matter	Ash	Protein	Crude fiber	Nitrogen-free extract	Ether extract or fat
Experiment I—Per cent digested	65.12	66.27	52.87	68.54	54.29	71.77	72.15
Experiment II—Per cent digested	66.98	68.43	51.58	71.27	60.83	71.41	70.26
Average digestibility of vetch hay—Per cent	66.05	67.35	52.23	69.91	57.56	71.59	71.21

The digestibility of the food nutrients in the vetch hay seems to be higher than the average which is usually given for forage plants. Nevertheless, it would seem that the digestibility of the protein was somewhat lower than it would have been had the vetch been cut earlier. The vetch, when cut was slightly overripe, consequently the hay contained many matured seed rich in protein which the cattle were unable to digest. When the cattle were fed this vetch hay, their feces contained many undigested seed. Had the vetch been cut a few days earlier, namely, when the pods were only partially filled, then its digestibility would have doubtless been higher than these feeding trials indicate.

These results show the very great value of vetch as a forage plant where it can be successfully grown.

Experiment III (Concluded).—Golden Alice fed corn silage.

	Dry substance	Organic matter	Ash	Protein	Crude fiber	Nitrogen-free extract	Ether extract or fat
	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs
Golden Alice consumed from 6 P. M. Dec. 2 to 6 P. M. Dec. 8, 858 lbs. corn silage which contained	62.68	58.08	4.55	5.44	14.89	32.00	4.40
Golden Alice produced from 6 P. M. Dec. 8 to 6 P. M. Dec. 9, 108.25 lbs. feces which contained....	17.21	14.78	2.48	2.58	3.59	8.10	.45
Digested.....	45.37	43.30	2.07	2.91	10.80	23.90	3.95
Per cent undigested.....	27.60	25.38	54.50	46.51	24.95	25.31	10.23
Per cent digested.....	72.60	74.62	45.50	53.49	75.05	74.69	89.77

Experiment IV (Concluded).—Cross-bred heifer fed corn silage.

	Dry substance	Organic matter	Ash	Protein	Crude fiber	Nitrogen-free extract	Ether extract or fat
	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs
Cross-bred heifer consumed from 6 P. M. Dec. 2 to 6 P. M. Dec. 8, 851 lbs. corn silage which contained	59.31	54.85	4.46	5.34	14.11	31.38	4.32
Cross-bred heifer produced from 6 P. M. Dec. 8 to 6 P. M. Dec. 9, 119.38 lbs. feces which contained	15.624	13.414	2.21	2.32	3.44	7.34	0.43
Digested.....	43.686	41.436	2.25	3.02	10.67	24.04	3.89
Per cent undigested.....	26.84	24.45	49.55	43.44	24.38	23.39	9.95
Per cent digested.....	78.66	75.55	50.45	56.56	75.62	76.61	90.05

The results derived from experiments III and IV indicating the digestibility of the food nutrients of steamed corn silage are as follows:

	Dry substance	Organic matter	Ash	Protein	Crude fiber	Nitrogen-free extract	Ether extract or fat
Experiment III—Per cent digested.	72.60	74.62	45.50	53.49	75.05	74.69	88.77
Experiment IV—Per cent digested.	78.66	75.55	50.45	56.56	75.62	76.61	90.05
Average digestibility of corn silage, per cent.....	73.08	75.09	47.98	55.03	75.34	75.65	89.91

These results show that in the feeding trials here recorded, considerably more of the carbohydrates and ether extract or fat is digestible than is usually given by authorities. This may be due to the fact that the corn fodder was steamed.

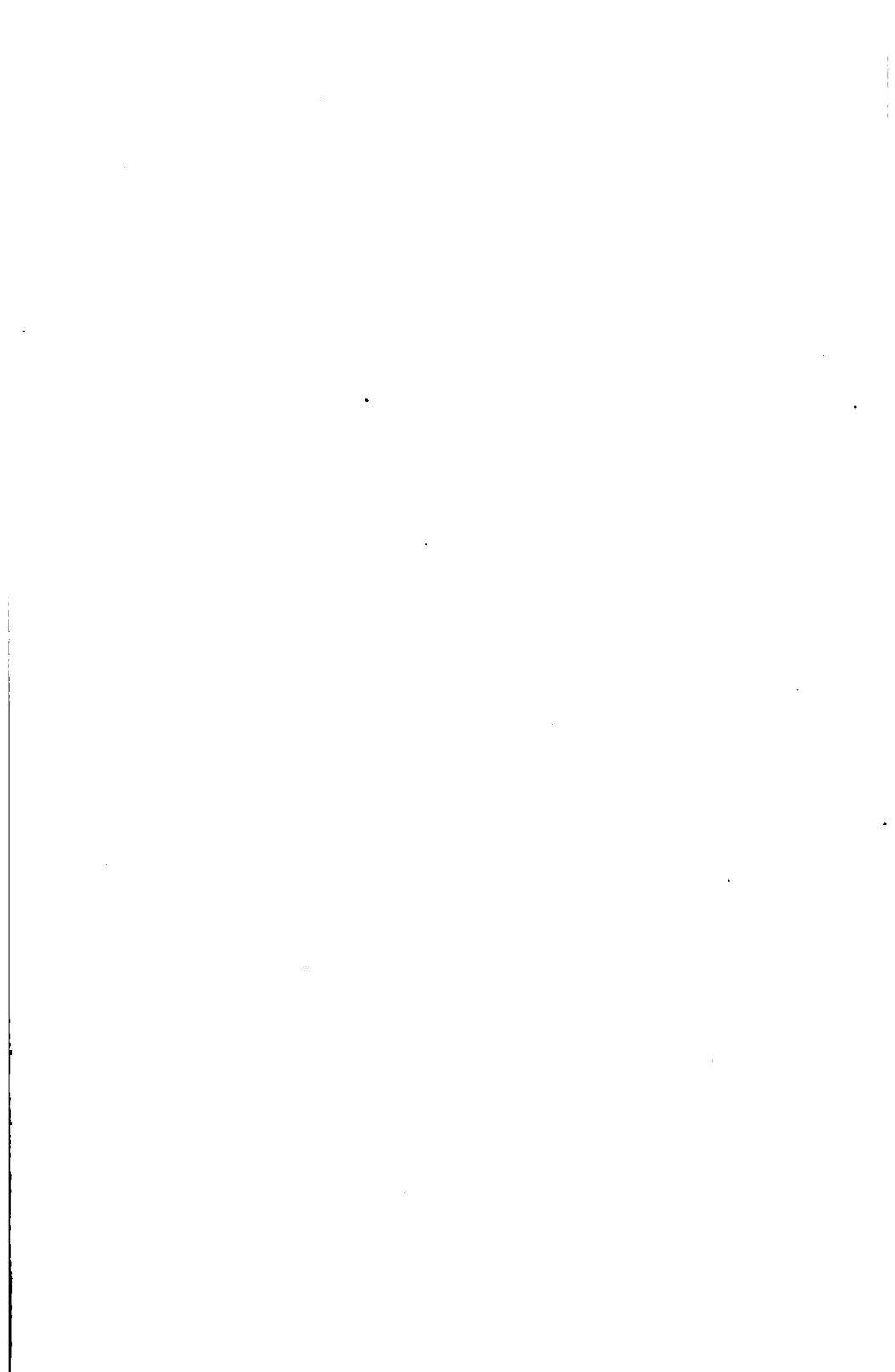
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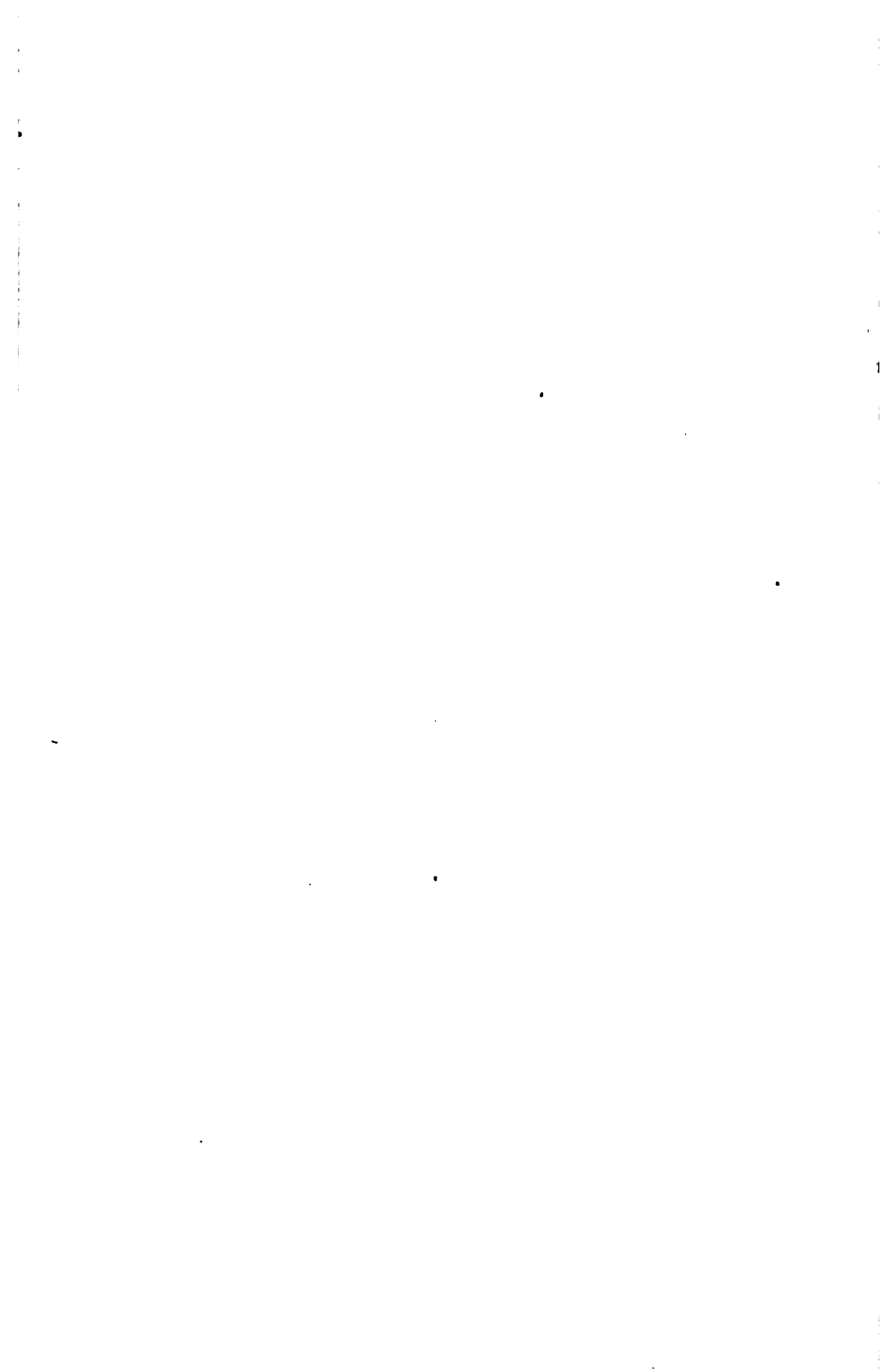
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April, 1905.

DEPARTMENT OF AGRICULTURE.

Oregon Agricultural Experiment Station.

CORVALLIS, OREGON.

Irrigation in Klamath County

**Cooperative Irrigation Investigation with the Office
of Experiment Stations, United States
Department of Agriculture.**

By F. L. KENT.

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Corvallis, Oregon

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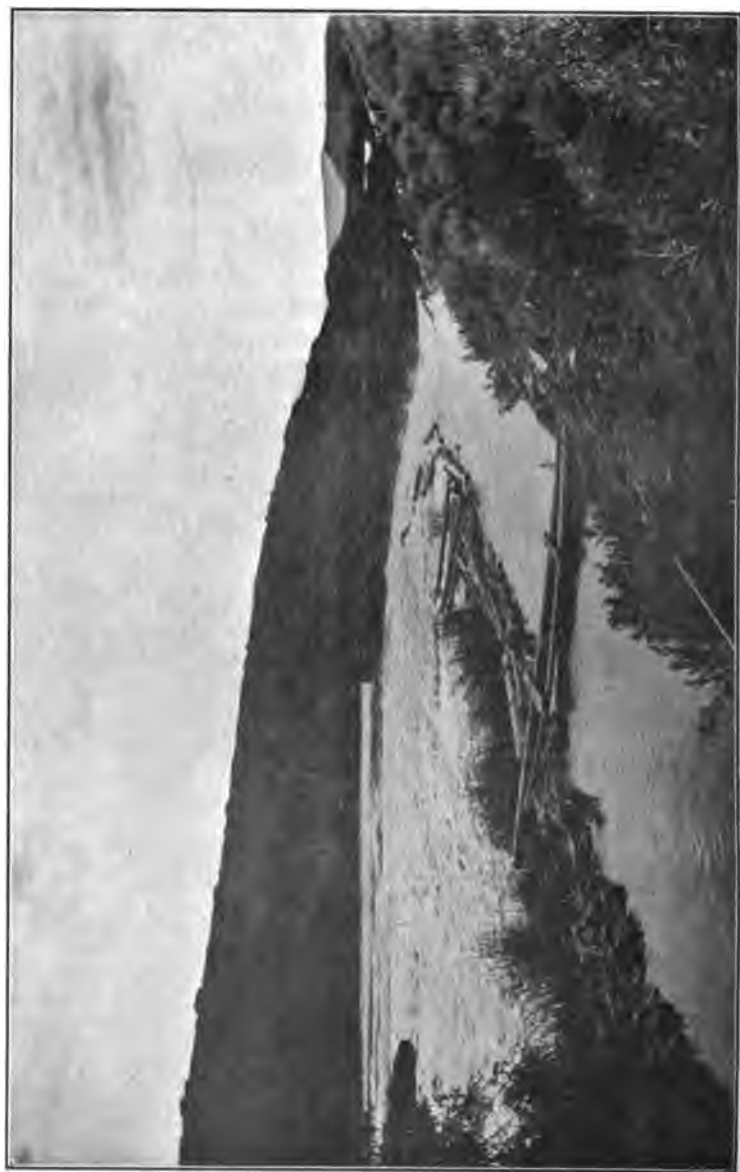
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I. WING DAM AT INTAKE OF ANKENY CANAL.

INTRODUCTION.

Irrigation has been practiced in Klamath County for a considerable time, the property of the Klamath Falls Irrigation Company, commonly known as the Ankeny Ditch, having been built in 1884, and that of the Little Klamath Ditch Company, locally known as the Adams Ditch, having been built in 1885. Each of these systems have been enlarged to more than twice their original water carrying capacity. The first named system is now supplying water to about 4,000 acres, but could easily be enlarged to cover about 10,000 acres, which amount of land lies within easy reach. Under this system water is sold on the basis of \$2.50 per California miner's inch, each user taking about one inch for every two acres. The water supply is taken directly from Klamath Lake, and distributed along about 16 miles of main ditch.

The Little Klamath Ditch Company (Adams Ditch) takes its water supply from Little Klamath Lake, by a channel recently cut through about four miles of tule growth discharging into White Lake, thence through a deep cut of about one mile into the Lost River valley. Here two branches about eight miles in length supply about 5,000 acres, on the south side of Lost River, while the greater portion of the water passing through the cut is flumed across Lost River, and distributed by means of two main ditches of about 32 miles total length, to about 8,000 acres. Under this system water is delivered to users at the rate of \$1.50 per acre for the season. That portion of the water which is not flumed across Lost River belongs to a stock organization known as the Van Brimmer Ditch Company, which operates about as follows: There are about 5,000 acres under the ditch, each acre of which represents one share. On May 1st, 1903, when the ditch property was purchased from Van Brimmer Bros., the originators of the system, the sum of \$5.00 per share was paid in for the purchase of the property. The cost of maintenance is to be assessed pro rata per share, and it is estimated that this item will amount to less than 25 cents annually, which assumption is warranted by the results of the past two growing seasons.

On Sprague River, the North Fork Irrigating Company and the Sprague River Irrigation Company each cover about 2,000 acres. These ditches are about twelve and eleven miles long respectively which lengths include the principal laterals. They are both stock concerns, the shares being held by the water users.

On Wood River Prairie, which lies northward of Klamath Lake, some 3,000 or 4,000 acres are irrigated from the mountain streams fed by the snows of Crater Lake Mountain (Mt. Mazama) and other high elevations. Here, as on Sprague River, the water is very cold

(54°F. observed at 2:00 p. m. July 7th) and is used mainly for the irrigation of wild grasses. It is doubtful if simpler irrigation engineering problems can be found anywhere than those of the Wood River prairie. The whole area slopes uniformly toward the south with a fall of 3 to 5 feet per mile. Wood River and smaller streams have such very low banks that the water may be diverted at almost any point. The uniformity of the surface, and the ease with which the soil is worked, make it possible, as reported, with three horses on a plow, and six on a road machine, to construct between four and five miles of "surface ditch" in a day. And the system of applying the water is quite as simple. As one user expressed it, "there is no system; water is simply led out on the higher lands and allowed to flood those of a slightly lower level." The water is generally turned on to wild meadows about June 1st and left on from four to six weeks.

Under the Ankeny and Lost river systems, the principal crop grown is alfalfa, although wheat, oats and barley are largely grown. Alfalfa yields four to five tons of hay per acre per season, there being two cuttings. Wheat yields, per acre, 20 to 30 bushels; oats, 30 to 50 bushels and barley 40 to 60 bushels. Two, and sometimes three irrigations per season are applied to alfalfa; the first about May 15th, and the second about July 15th. Grain usually gets but one irrigation and that about June 15th to 30th. Irrigators estimate that about the same amount of water is applied at each of the aforementioned irrigations.

In addition to the systems already mentioned, considerable irrigation is done with the water of springs. The Griffith and Bord water wheels on lost River each furnish sufficient water to irrigate 250 acres, and Mr. F. J. Bowne of Bonanza (upper Lost River Valley) has this year installed a steam pumping plant designed to supply water for the irrigation of about 1800 acres.

Climatic Conditions.—Some idea of the climatology of the region may be gained from the Weather Bureau reports as furnished by voluntary observer, Marion Hanks, near Klamath Falls, and set forth in the table below:

RAINFALL.

Year	Jan.	Feb.	Mch.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1901.....	5.80	1.85					T	T	1.68	.90	1.29	2.29	
1902.....	T	2.50	.50	1.17	.50	.00	T	1.75	.00	.85	.79	8.20	11.26
1903.....	8.90	T	1.18	.20		1.98	.00					1.35	
1904.....	1.00	4.60	3.62		.45	.75							

MONTHLY TEMPERATURE AVERAGES.

	25.2	31.8	37.6	43.7	54.8	57.2	68.1	70.0	54.6	51.9	40.8	32.6	47.3
1901.....	25.2	31.8	37.6	43.7	54.8	57.2	68.1	70.0	54.6	51.9	40.8	32.6	47.3
1902.....	30.2	37.8	38.6	45.2	52.8	60.7	63.2	68.3	64.0	47.4	36.4	33.3	43.3
1903.....	31.6	26.8	37.8	45.8		63.4	65.1					33.8	
1904.....	37.2	30.8	33.3	47.2	58.0	59.0							

In the Wood River region the average temperature is somewhat lower and the precipitation somewhat greater than near Klamath Falls, while in the Lost River region the average temperature is higher and the annual precipitation rather less. The Sprague River section very closely resembles the Wood River region as to temperature and precipitation. The whole area is above an elevation of 4,200 feet, consequently summer frosts are quite liable to occur.

The work discussed below was carried on during the months of July and August. A very unusual rainfall during the first ten days of the month of July interfered with the work, as the Ankeny ditch was injured to such an extent that it supplied no water to users for more than a week. An unusual amount of spring rain delayed plant growth and threw the irrigating periods considerably later than usual. In fact the July rains furnished so much water that several growers deemed it unnecessary to irrigate their grain crops, hence it is probable that the duty of water as indicated by these investigations is higher than would ordinarily be the case.

Units of Measurement.—Three units of measurement are in common use in estimating the amount of water used in irrigation, viz: (1) the inch; (2) the cubic foot per second; and (3) the acre-foot or acre-inch. These units may be briefly defined as follows: The *inch* is the volume of water that will flow through an inch square opening under a specific and uniform pressure. The different pressure requirements of various state statutes cause a considerable variation in the quantity of water represented by the *inch*. The *cubic foot per second* or *second foot* as it is also called, is a discharge or flow of one cubic foot in one second of time, or the equivalent thereof. Since this unit is always a definite quantity, and is adapted to various methods of measurement, it is much to be preferred in accurate determinations, and is gradually displacing the inch as a unit of measurement. The *acre-foot* is the amount of water required to cover one acre of land to a depth of one foot. The *acre-inch*, sometimes used, is the one-twelfth part of the acre-foot.

In the discussion of the use of water which is to follow, the cubic foot per second has been taken as the basis of computation. In order that it may be readily converted into terms of the *inch*, and the *acre-foot*, the following equivalents are given:

One cubic foot per second.....	50 California inches
One " " " in 24 hours.....	1.98 acre feet
Also:	
One " " ".....	7½ gallons per second (nearly)
One " " ".....	450 gallons per minute (nearly)

1. Losses on Adams Ditches.—(a) "Old ditch"; about 600 feet below Lost River flume; area of cross section, 16.09 square feet; velocity, 1.056 feet per second; discharge, 16.99 cubic feet per second. Measured at a point about 6 miles below; area of cross section, 12.4 square feet; velocity, 1.12 ft. per second; discharge 13.88 cubic feet per second. Add 1.37 cubic feet per second for amount being used, discharge is equivalent to 15.25 cubic feet per second or a loss by

evaporation and seepage in the 6 miles of 1.74 cubic feet per second equal to a percentage loss of 10.24 per cent. The original survey of this ditch gives it a fall of 1.8 feet per mile.

(b) "New ditch", about 300 feet below Lost River flume; area of cross section, 41.65 square feet; velocity, .436 foot per second; discharge 18.16 cubic feet per second. Measured at a point about 8 miles below: Area of cross section 18.55 square feet; velocity, .856 foot per second; discharge, 15.88 cubic feet per second, which gives a loss in the 8 miles of 2.28 cubic feet per second or a percentage loss of 12.55 per cent.

This ditch is constructed on an average grade of .7 foot per mile but is not strictly uniform. Above determinations made on July 15 and 16 respectively.

2. Losses on Ankeny Ditch.—Measured about $\frac{1}{4}$ mile below headgate and about 200 feet below point at which water is taken out for power purposes. Discharge 43.41 cubic feet per second. Measured at a point about 6.5 miles below: Discharge 35.57 cubic feet per second; loss 5.84 cubic feet per second, or 13.5 per cent. These determinations were made in company with Mr. T. H. Humphreys of the Reclamation Service, using a Price current meter. This determination made about August 20.

Determinations made on August 9th by the use of rod floats gave results as follows: Area of cross section 200 feet below power plant, 23.1 square feet; velocity, 1.904 feet per second; discharge, 43.98 cubic feet per second. Area of cross section, about 6.5 miles below, 27.35 square feet; velocity, 1.33 feet per second; discharge 36.38 cubic feet per second. Add 2 cubic feet per second being used, discharge equivalent to 38.38 cubic feet per second, indicating a loss of 5.6 cubic feet per second, or a percentage loss of 12.73 per cent.

This ditch was built on a grade of 1.0 foot per mile for the distance above mentioned. The first mile follows a very rocky and in places, steep hillside, where much of the loss doubtless occurs.

3. Losses on Mitchell Lateral.—Aug. 9. Water measured over Cippoletti weir $\frac{1}{2}$ mile from headgate; discharge, 3.92 cubic feet per second. Measured over rectangular weir, where used in field, about $1\frac{1}{2}$ miles from Cippoletti weir; discharge, 3.12 cubic feet per second, being a loss of .8 cubic feet per second or a percentage of 20.4%.

For a large part of the distance between the weirs this lateral was overgrown with sweet clover, alfalfa, etc., while in other places occasional gopher holes allowed considerable water to escape. It doubtless represented as unfavorable conditions as would be found on any of the laterals of the Ankeny system.

4. Duty of Water on N. S. Merrill's 38.5 Acre Tract of Alfalfa.—July 24-28. In this case a regulation Cippoletti weir, with flume and Gurley water register were installed according to regulations prescribed in Irrigation Investigation Schedule No. 2, dated March 1, 1899. The weir had a three-foot crest and at no time did the water flowing over it reach a greater depth than six inches. Water was turned in at

9:00 A. M., July 24, and from 12:00 noon on July 24 to 12:00 noon on July 29 the depth over weir ranged from 4 to 4½ inches. From then until turned off at 5:00 P. M. on July 28, the depth ranged from 5½ to 6 inches on weir crest. The total amount of water applied amounted to 20.0868 acre-feet or an average application over the entire 38.5 acres, of a depth of 6.27 inches. In the opinion of Mr. Merrill, who personally applied the water, this amount was about the usual quantity he has been in the habit of applying at each of the two irrigations annually given this area, for several years past.

The measuring weir was placed in the lateral about 200 yards from the main ditch, and about 200 yards below the weir the water was applied to the field. The checking system was used, and is the method generally followed among the water users of the Lost River systems.

5. Duty of Water on N. S. Merrill's 5.0 Acre Tract of Alfalfa.—July 28-July 30. In this case the water was as carefully measured as in the preceding instance, passing over the same weir, but instead of being applied about 200 yards below the weir it was conducted in the lateral about one mile before being applied. Then, too, at one point the water broke over the check levee, and a considerable amount ran onto other lands. Again, there was fully six inches of water in parts of some of the checks, 24 hours after the water was turned off. These facts indicate that the results are considerably higher than would normally be obtained. The weir measurements indicated that 8.768 acre-feet of water was applied, or an average depth of 1.753 feet. Considering the small area, and the large wastes this result is not considered of much value.

6. Duty of Water on Wm. Ball's 40 Acre Alfalfa Tract.—July 17-21. Owing to delay in getting water into the main ditch this field did not receive the irrigation which it naturally should have had about the middle of June, hence had received no water prior to that applied at the time the following determinations were made. The lateral was a new one, perfectly straight for a quarter of a mile, hence surface floats could be used to advantage. Results were as follows: Area of cross section, 3.528 square feet; velocity, 1.48 feet per second; time, 68 hours. Number acre-feet of water applied, 29.289, equivalent to a depth of 8.78 inches. Observations were made three to five times daily. A break in the lateral made it necessary to turn out the water for about 18 hours.

7. Duty of Water on Wm. Ball's 95 Acre Alfalfa Tract.—July 23-27. This may be considered as a normal field, having had the usual irrigation about June 15th. Water for the irrigation upon which observations were made was applied by two laterals which were designated A and B. The flow of water was practically constant from the time of turning on at 12:00 noon, July 23, to 8:00 A. M. July 25, at which time there was a fall of about 3 inches. This

level was practically maintained for the remainder of the irrigation period. Results were as follows: Lateral A; area of cross section, 5.25 square feet; average velocity, .616 foot per second; time, 44 hours; discharge, 11.739 acre-feet. Also, area of cross section, 4.095 square feet; average velocity, .614 foot per second; time, 60 hours; discharge, 12.44 acre-feet. Total discharge for A 24.179 acre-feet. Lateral B. Area of cross section, 10.125 square feet; average velocity, .32 foot per second; time, 44 hours; discharge, 11.75 acre-feet. Also, area of cross section, 9.0 square feet; average velocity, .267 foot per second; time, 60 hours; discharge, 11.89 acre-feet. Total discharge for B, 23.65 acre-feet. Combined discharge of A and B, 47.829 acre-feet, equal to a depth of 6.048 inches over 95 acres.

In this case the area irrigated was nearly square, one side of which was bounded by the main ditch from which the water was taken. The slight fall made the use of a weir out of the question. This determination, as well as Nos. 4, 5 and 6 were made under the Adams system.

8. Duty of water on 118 Acre Alfalfa Field Owned by Ankeny & Cantrell (free flooding). August 8-11. Measured with rectangular weirs without end contractions. Irrigated from two laterals, A, delivering 17.009 acre-feet, and B, delivering 31.448 acre-feet. Total supplied by both laterals, 48.457 acre-feet. Applied to 118 acres is equivalent to a depth of 4.92 inches. The apparently high duty of water on this field is aided by three conditions, viz., large volume of water used; plants had made considerable growth since cutting, thus lessening evaporation; considerable drainage water from an adjoining field had spread over this one but four or five days previously. And further, some of the higher spots in the field received no water on their surface. That part of the field nearest the main ditch was about one-fourth mile distant.

9. Duty of Water on 110 Acre Alfalfa Field, Owned by Ankeny & Cantrell (check system).—August 14-18, measured with rectangular weir without end contractions. 54.2 acre-feet applied to 110 acres, equivalent to a depth of 5.92 inches. The lower duty of water in this case as compared with No. 8 is doubtless due to the following conditions: (1) The application was made about a week later; (2) comparatively little plant growth covered the field; (3) no drainage from other fields had occurred; (4) a more uniform application of water was made by reason of the land being "checked." The two fields laid side by side for the greater part of their length, and were each about the same distance from the main ditch. The field of No. 8 had a less uniform surface, and a slightly lower average level.

10. Comparison of Labor Required in Nos. 8 and 9, and Opinions as to Relative Merits of the Two Systems Used.—In No. 8 (free flooding) two men and a team were required for one day, plowing furrows and otherwise preparing ditches for the distribution of the water. The



III. HEADGATE ANKENY CANAL.

services of two men for five days were required to apply the water. And the days were very long and very arduous. Allowing \$2.50 per day for each man, and \$2.00 for the team, the cost of spreading the water on the 118 acres amounts to \$32.00 or about 27 cents per acre.

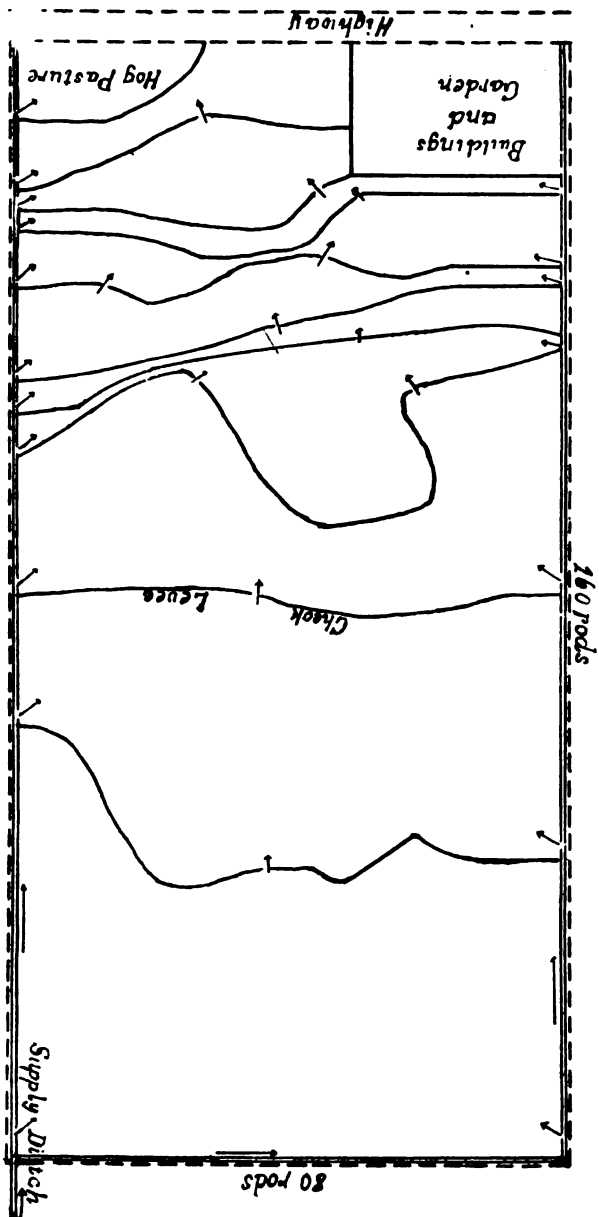
In No. 9 (check system) practically no preparation was required before turning on the water, and one man was easily able to attend to the handling of the water which required five days to supply the 110 acres. Making the same wage allowance as before, the cost would amount to \$12.50 or a little more than 11 cents per acre.

The cost of preparing land for the application of the check system depends to a considerable extent upon the contour of the land. Mr. N. S. Merrill, who is a firm believer in the merits of the system, estimates that his checking has cost him about \$10.00 per acre, but he has some land upon which the check levees are not more than one rod apart with a fall of one foot between checks.

Mr. J. F. Adams, who has superintended a large amount of check construction, says that one man with a "Fresno Buck Scraper," and a four-horse team can construct about one-fourth mile of checks per day for a three-inch fall, and such a working outfit is worth about \$5.00 per day. On this basis, using as an example the 80 acre field of Mr. M. E. Robinson (a sketch of which accompanies this report), the cost of constructing the check levee would amount to about \$60.00. The cost of locating the levees would probably amount to \$20.00 additional, making the cost of putting in the checks about \$80.00 or about \$1.00 per acre in this particular case. This is an ideal field for the application of the checking system although there are other checked fields of equal area in the Lost River system which have a less amount of levee work. To the above estimate should be added the cost of putting in twenty gates, two for each levee, although in many cases canvas, manure or dirt dams are used in the laterals instead of gates. The manure or dirt dams are not to be recommended as they require too much labor.

A peculiar feature of the practice of water users under the Adams and the Ankeny ditches is their attitude toward the use or non-use of the checking system. Ankeny and Cantrell are practically the only users of checks under the Ankeny ditch, and they propose to decrease and perhaps eliminate their checked area, while practically all of the users under the Adams ditch follow the check method. The lands covered by these two ditches approach within less than ten miles of each other, and to a close observer there appears to be no particular difference in the character of the soils, except perhaps the presence of a little more sand, and a trifle less clay in the region served by the Adams ditch.

11. Evaporation.—In the absence of a regular evaporation pan, a pan 13x9 inches, and 9 inches deep, enclosed in a wooden framework suitable for properly floating the pan, was placed in the



II. Eighty acre checked field of M. E. Robinson (Adams ditch system). Fall between checks, three inches. The arrows indicate inlets of water to checks. When applying water, temporary dams are placed in the supply ditches just below the inlets to the first check. When this check is properly filled, dams are placed at the inlets to the second check, and the first dams removed. This is repeated till all checks have been filled, each one except the first being partially supplied by the drainage from the check above. The long straight arrows indicate the direction of flow in the supply ditches.

Adams ditch on July 24 and filled to a depth of seven inches. The evaporation by seven-day periods was as follows: First period, 2.5 inches; second period, 3.125 inches; third period, 2.5 inches; fourth period, 2.0 inches; next three days, .875 inches. Total for 31 days, beginning July 24, 11.0 inches.

12. Collection of Samples of Soil and Irrigation Waters for Analysis.—

(a) SOILS: Two samples of soil were taken to determine the effect upon the soil of the continued growing of alfalfa irrigated from the waters of the Adams ditch. The claim had been set up that the waters of this ditch carried a considerable amount of organic matter by reason of the water slowly passing through a considerable area of tule growth before reaching the ditch, hence its use would tend to build up the land irrigated therefrom. Sample A was taken from virgin soil which had never been irrigated. Sample B was taken from a field which had been growing alfalfa continuously for nine years, having grown just one grain crop prior to being seeded to alfalfa. The samples were taken about 150 feet apart and represented apparently exactly the same original soil conditions.

The results of the analyses are as follows:

	Sample A. (Virgin soil).	Sample B. (Nine years in alfalfa).
Potash, K_2O	.43 per cent.	.41 per cent.
Lime, CaO	1.56	.96
Magnesia, MgO	.11	.06
Phosphoric acid, P_2O_5	.09	.085
Nitrogen.....	.166	.177

(Determinations by F. E. Edwards, Oregon Agricultural College.)

These analyses indicate that the soil nitrogen is increased by the growing of alfalfa, under the irrigated conditions already described, but whether the increase in the nitrogen content is due to the character of the irrigation waters, or to the growing of the alfalfa on the land is not determinable in this case. The other essential elements of plant growth are seen to have considerably decreased.

(b) IRRIGATION WATERS: The waters of Lost River which are used at the F. J. Bowne pumping plant, come from a large number of springs. An analysis of this water with reference to its use both for boiler and irrigation purposes gave the following:

	Parts per million.	Grains per gallon.
$NaCl$	5.3	.81
Na_2SO_4	11.0	.64
Na_2CO_3	1.0	.06
K_2CO_3	8.7	.22
$MgCO_3$	98.0	5.43
$CaCO_3$	77.5	4.86
Fe_2O_3 {	5.2	.80
Al_2O_3 {		
SiO_2	22.9	2.24

(Determinations by F. E. Edwards, Oregon Experiment Station.)

The following analyses made by A. L. Knisely and F. E. Edwards of the Oregon Experiment Station, give an idea of the composition of the irrigating waters furnished by the Ankeny and the Adams ditches:

Parts per Million.

	1 Little Kl. Lake	2 Adams	3 Ankeny	4 Adams	5 Ankeny
Total solids (110°C).....	307.0	467.0	128.0	369.6	174.4
Organic matter.....	76.0	98.0	.....	80.0	60.0
Silica (SiO ₂).....	34.0	16.0	37.0	46.0	40.0
Sodium chloride (NaCl).....	50.9	75.4	50.9	23.0	12.5
Sodium carbonate (Na ₂ CO ₃).....	49.0	133.7	20.9	148.4	31.8
Sodium sulphate (Na ₂ SO ₄).....	10.5	5.5	5.5	35.5	42.5
Calcium carbonate (CaCO ₃).....	125.0	107.5	50.0	38.0	35.2
Magnesium carbonate (MgCO ₃).....	.....	21.7	.....	68.4	.....
Nitrogen (N).....	8.4	9.8	6.2	2.6	2.1
Iron and alumina (Fe ₂ O ₃ +Al ₂ O ₃).....	.....	.....	.....	.....	2.9

For grains per gallon use the divisor 17.12

Nos. 1, 2 and 3 are from samples taken in 1903, and 4 and 5, from samples taken in 1904. Nos. 2 and 4 were taken at practically the same points and season of the year, viz., about August 1st, at which time the ditches were carrying an average quantity of water and the same may be said of Nos. 3 and 5. No. 1 was taken for the purpose of determining whether any considerable change took place in the composition of the water used by the Adams ditch by reason of passing through the tule growth and White Lake. The results seem to indicate an increase in both organic matter and soluble salts, particularly sodium and magnesium carbonates.

Sodium chloride (common salt), and sodium carbonate (sal soda) are component parts of the so called "black alkali." Sodium sulphate (Glauber salts), and calcium carbonate (lime), enter into the composition of "white alkali." The above analyses indicate that the water from either of these sources would be considered perfectly safe for irrigation purposes.

13. Data Relative to Alfalfa Growing.—Several growers were interviewed under each of the two systems previously referred to, the results indicating that there was no essential difference in the methods followed under the two systems. In the matter of preparing the ground it is the practice to grow grain for two or more years after clearing away the sage brush, before sowing to alfalfa. The seeding is uniformly done with a drill, and as a rule no "nurse crop" is used. When such a crop is sown, barley seems to be preferred. 8 to 10 pounds of seed per acre is the amount usually sown, although one grower recommended 20 pounds, and another regarded 6 pounds, or even less, as being sufficient if it could be evenly applied. The time for seeding has quite a range, some preferring to sow early in April. Others consider June 1 to 15 as the proper season. One of the oldest and most successful growers says he has had excellent results from sowing during the latter part of February. If the seed is sown early, that is, prior to May 15, it will not as a rule require irrigation to start a vigorous growth. Two

irrigations are usually given the fields, but there is a growing sentiment in favor of three applications of water, and it is the opinion of the writer that the latter practice will soon become general.

With three irrigations they would come about four weeks apart beginning usually about May 15.

The first cutting usually takes place about July 1, and yields 2 to 2½ tons of hay per acre. The second cutting usually takes place about September 15 and yields 1½ to 2 tons per acre. From four to six weeks fall pasture is usually obtained after the removal of the second cutting. The renewal of an alfalfa field is usually recommended after 7 to 9 years of growth, although some well cared for fields seemed to be in prime condition at 12 to 14 years of age. Treatment similar to that given new land is recommended before re-seeding to alfalfa.

In the opinion of some of the most successful growers, more damage is done by the use of too much water and imperfect drainage than from the use of too little water. Especially is this true under the checking system. It certainly does not take an experienced eye to see that there is much waste of water under each of the ditch systems which have been discussed.

SUMMARY.

The discussions in the foregoing pages seem to indicate:

1. That in the soils of the region considered the losses by seepage and evaporation are comparatively small, ranging between 10.24 per cent and 13.5 per cent in the three cases observed on main ditches.

2. That the percentage losses in laterals may be considerably greater than in the main ditches.

3. That the duty of water was rather high, a depth of only 4.92 to 6.27 inches being required to produce the desired moisture conditions for the second irrigation of alfalfa fields.

4. That the cost of applying water to checked fields, after the land is properly fitted, is less than one half the cost of application in free flooding.

5. That during the height of the growing season the evaporation from a water surface may amount to a depth of 11. inches in 31 days.

6. That chemical analyses show the waters of this region to be very desirable for irrigation purposes.

7. That while two irrigations are commonly given alfalfa fields each season, there is a growing tendency toward the use of three.

NOTE:—The writer desires to express his appreciation of the courteous treatment and liberal assistance given by the parties mentioned in this report, as well as by others in the vicinity.

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Oregon Agricultural Experiment Station.

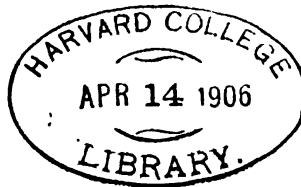
CORVALLIS, OREGON.

CANNING FRUIT AND VEGETABLES. PRESERVING FRUIT JUICES.

By E. F. PERNOT.

THE BULLETINS OF THIS STATION ARE SENT FREE TO ALL RESIDENTS
OF OREGON WHO REQUEST THEM.

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From S. A. Brown

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Canning Fruit and Vegetables.

E. F. PERNOT.

The art and science of canning fruit, vegetables and other perishable food stuffs, is to preserve them, as near as possible, in their natural condition.

The material should retain its original flavor, color, odor and structure; in fact, when a can is opened, its contents should be unchanged from the condition in which nature produced it.

Unfortunately, the problem has not been wholly solved, although much work has been done and will yet be done to accomplish this end.

The present method of canning on a commercial scale, has forced the adoption of an extremely high temperature, in order to destroy the spores of organisms which act as decomposing agents on the material. The temperature ordinarily used is from 230° to 250° F., and the length of time which this high temperature is maintained is from 20 to 30 minutes.

This processing answers the purpose for some kinds of material, such as: meat, fish, bivalves and certain vegetables, especially fish, in which it softens the bones to about the consistency of paraffine, rendering the smaller ones edible, but for fruit and most vegetables it is detrimental, for it destroys the delicate tissue, causing the material to become "mushy," especially when transported long distances; the plant albumen becomes coagulated and much of the flavor is destroyed by the driving off, or volatilization of the essential oils; this is more pronounced in some vegetables than in others. The commercial canned goods have a very different odor and flavor from the fresh material, which is mostly due to the extremely high temperature at which they are processed.

With the aim in view, of possibly raising the quality of canned goods, experiments with different temperatures, in canning, and a study of detrimental organisms, has been carried on for two years, and the results, both good and bad, are herein recorded.

Micro-organisms, not unlike all other plants, possess the power of self-preservation and of perpetuating their kinds; one is by means of producing spores, or seeds, which are very resistant; while others, which do not produce spores, have a resisting power nearly equal to that of spores.

In the latter-mentioned, the germ itself, which is termed the vegetative cell, it is usually destroyed by an exposure, for a few minutes, to a temperature of 160° F., while its spore would resist boiling heat for a much longer time.

In canning material for food the spore-bearing varieties usually cause the most annoyance, and the object of this experiment was to find a means of destroying both germs and spores, at a temperature not injurious to the structure, flavor or color of the material being canned.

The operations consisted of cleaning the cans by means of a brush, using hot water to which an alkaline washing powder had been added; this removed any trace of acid soldering flux, or free lead or tin; after cleaning, the cans were steamed over a steam jet, to remove any dirt or impurity which might remain.

The vegetables, such as peas, beans, asparagus, etc., were well washed and placed in the cans, completely filling them; water was then added to fill the interstices, cap placed in position on can and soldered, leaving the vent open; the cans were then placed in a wooden steam chest and heated until the thermometer registered a temperature of 165° F., in the center of the cans; this temperature was maintained for fifteen minutes.

The cans were then removed from the chest and vents immediately closed by soldering.

After being allowed to stand for twenty-four to forty-eight hours, the cans were again heated as before, and the operation repeated for the third time; after which, the content of the can was sterile.

This is sterilizing by intermittent pasteurization, the principle of which is to destroy the vegetative cells by the first heating; most of the spores then germinate into cells during the first intermission and are killed by the second heating; should any spores remain after this second heating they germinate during the second intermission and are destroyed by the last heating.

In this way vegetables and fruit may be sterilized in cans, leaving them practically in their natural condition.

Fruit containing pits could not be preserved in this manner without first removing the pits, as there would be danger of their germinating when kept in an warm atmosphere.

Perhaps this method of canning could not readily be adopted by establishments where large numbers of cans are filled daily, owing to the additional expense and space required in handling them

three times; yet, this would be partly counterbalanced by the requirement of less fuel for steam production, and using not so expensive retorts; still it would be too expensive for ordinary commercial goods which are placed on the market at such low figures; but for a high-priced first-class article, the superior quality would warrant this additional expense, and we could have upon the market a grade of goods far above those ordinarily found.

Each and every kind of material to be canned requires treatment peculiar to itself. All kinds of fruit and vegetables cannot be placed in cans and sterilized with equally good results, without previously preparing them.

Some vegetables, especially, are much benefited by blanching, as practiced in some canneries, as it removes dirt and all gummy substances which teem with bacteria; the strong, crude taste is also removed, making the material much more delicate.

Blanching consists of dipping the vegetables into boiling water, to which a small amount of salt has been added, until they are softened, then quickly cooling in cold, running water, where they regain their firmness.

Prior to canning the different fruits, they are treated in various ways. They may merely be placed in cans, then covered with boiled water, sealed and sterilized, or, syrup may be added instead of water, the syrup varying in strength from 30% to 40% sugar.

A proper degree of ripeness of the fruit and vegetables is an immensely important factor to be considered in canning products which are intended to be first class.

Corn and peas, under-ripe, go too much to liquids when heated, leaving empty, untempting hulls in the can; besides this, very young corn and peas are more watery, not having acquired their flavor, nor nutritive value, and they are highly susceptible to fermentation.

Corn, cut from the cob, can remain in bulk but a very short time without fermenting or souring, especially in warm weather, for nature's protection from the action of organisms has been removed and an ideal culture medium exposed.

The same may be said of peas. A fermentation, so slight as to be undetectable, means an enormous multiplication of the organisms which cause it, with a corresponding loss of some valuable constituent of the food, and a production of ptomaines detrimental to the can or to the digestive tract of the consumer.

On the other hand, if corn and peas are over-ripe they become

farinaceous, lose their delicate flavor and form a turbid liquid in the cans, so that, the same good judgment used in selecting material for the table, should be exercised in the matter of canning.

Canning being the process of preserving food in its succulent form by destroying germs which infest it, and of protecting it from further invasion, it necessarily follows that cleanliness is essential and that only sound and pure material should be used.

The water or syrup used should be sterile in order to avoid adding many varieties of germs which are not already in the material.

These germs are the lowest forms of plants; they are infinitesimally small, and their spores yet smaller so that their actual size cannot be conceived.

Water, which is apparently pure, frequently contains fifty thousand of them to the cubic centimeter.

The amount of water necessary to complete the filling of a two-and-one-half pound can of material is about two hundred cubic centimeters; this would add to the contents of the can ten million more germs unnecessarily; besides the danger of introducing varieties which might carry toxic products; therefore, all liquids should be boiled before they are added to perishable material, even a salt brine should be boiled before using.

We find upon investigation that all material used for canning contains organisms; there are many varieties, some are saprophytic only utilizing the material after life is extinct or growth ceases; while others are parasitic, growing upon living matter; each vegetable appears to have some organism which makes that particular vegetable its normal habitat.

A green pea aseptically taken from a freshly opened pod and placed in a fermentation tube containing suitable culture media, generally gives rise to a strong bacterial growth, or fermentation, with the production of gas; this growth is much more pronounced when the pea contains a young weevil larvæ.

Most of the peas so tested caused a growth always accompanied by the production of gas.

The medium used was the juice from crushed pea pods diluted with water and sterilized in an autoclave at 240° F., for 30 minutes.

There seems to be no doubt but that the presence of weevil larvæ in fresh peas injure their keeping qualities after being picked, and make them more difficult to preserve in cans.

To produce a first-class article, peas must be canned soon after

they are shelled, as they are very susceptible to fermentation accompanied by the production of heat.

Green corn has also its parasitic and saprophytic organisms which are similar to those in peas, some being identical.

The culture medium used for growing those from corn, was water in which sweet corn was boiled after being crushed, then filtered and sterilized.

Organisms, taken from swelled corn and pea cans, grew equally well in either of the media.

In fermentation tubes containing bouillon with 2% grape sugar, they grew fairly well, but not so luxuriantly and produced less gas.

The only variation detected in the organism, when grown in different material, was in its morphology.

When taken from an old can of spoiled corn, the bacilli were much more curved than those taken from spoiled peas; the same peculiarity occurs when artificially grown in corn or pea media.

In all the swelled cans that were opened, both of corn and peas, the same organism was found.

It is an obligate anaerobe, *i. e.*, one which grows only in the absence of air; it readily forms long, oval spores which are situated near the end of single rods, and are very resistant to heat, its microscopical appearance and cultural characteristics are identical with *bacillus spinosus*, as described by Sternberg and Chester.

Cultures and smear preparations show that the organism is on the material before it is placed in the can, but there is nothing to indicate that it has a parasitic existence, or that it causes any injury to the plant while growing.

This organism produces gas while growing in the can and thrives best in the presence of its own gas.

One of its spores, having not been killed by the heat used in sterilizing, will eventually grow, and its vegetative cells multiply, producing gas to such an extent as to swell the can and ruin the material as an article of food.

Some of the cans in this experimental work gave no signs of deterioration for six months or more, after which time they began to swell, while others swelled after a few days.

This indicates that the spores, instead of being killed by the heat used, were only attenuated to such an extent as to be able to recover their vitality, and germinate long afterwards.

Upon this one point hinges the most essential factor in successful

canning; no matter what process or temperature is used, *the spores must be destroyed beyond all possibility of germination.*

The liquid in a can transmits the heat more readily than does the solid, hence the necessity of obtaining a reading of the temperature of the most dense part of the material in the can content, and unless they are subjected long enough to the proper heat, they will not be destroyed.

All of the tomatoes, green beans, wax beans, cauliflower, asparagus and cherries, canned by this method, kept perfectly, and are what may be considered the highest grade of canned goods. They have retained their natural color, flavor and texture; the beans when taken from the cans, may be broken as when they are fresh.

Some beans were canned in glass jars, but these jars can hardly be recommended owing to the difficulty of keeping them tightly sealed while heating the second and third time.

The beans taken out one year afterwards, were of the finest quality.

In this work some cans were filled with peas and some with corn, without adding water, so as to reduce weight and lesson shipping expenses; they were sterilized intermittently in the same manner as the others, but proved to be a failure, owing to an imperfect transmission of heat caused by the absence of water.

The canned corn and peas were a failure both years, even a temperature of 212° F. for twenty minutes, three successive days, failed to sterilize all of them; the only explanation for this is that corn and peas carry the bacilli previously mentioned, spores of which are so resistant to heat that they are not killed by the first heating, but are so attenuated as to prevent their germination in the intervals between the heatings, consequently they remain in the can as living spores and germinate after they have overcome the injury received by the heat.

Other lots were heated once to 240° F. for thirty minutes and have all kept, but the material is of an inferior grade.

Considerable work was done to ascertain the thermal death point of this organism and its spores.

Sterilized test tubes containing corn and peas, taken from spoiled cans, were placed in the autoclave and heated to different temperatures for various lengths of time, beginning with 160° F. for ten minutes and increasing to 200° for thirty minutes for three successive days.

After removing from the autoclave a portion of the material was

placed in fermentation tubes containing sterile media, by the aid of a sterile platinum loop; the tubes were then incubated, and in time gave a strong bacterial growth. Even some of those which were heated to 200° degrees for thirty minutes.

The temperature was determined while heating in the autoclave, by removing the regular thermometer and replacing it by a long, slender one, which passed through a cork into a test tube containing some of the same material as was being heated.

The tests were repeated with the same results by the use of a water bath and thermometer.

The samples tested, which were known to contain spores, (determined by smear preparations) nearly all survived the heating, while most of those which only contained the vegetative cells, were killed; this seemed to correspond with their behavior in the cans.

After some kinds of commercial material has been canned for a long time, it is found that there is a change in the flavor, which is often due to the actions of enzymes.

These enzymes are soluble or chemical ferments, sometimes produced by bacterial action on the material before it is canned, and are sometimes a natural part of the material.

The reaction is similar to the ripening of cheese or the aging of wine, and is not always detrimental to the product.

On the other hand, such material as canned minced clams, improve by age.

When they are freshly canned by a high temperature the heat contracts the fibre, forcing out the liquid, leaving it like minced rawhide, a condition in which it is very indigestible; but the longer the cans are allowed to stand the more the liquid is re-absorbed by the fibre, softening it to its normal condition.

In home canning, every matron has her own method, yet all methods resolve themselves into the essential principles of destroying all the organisms and spores, and of protecting the material from further infection. Another essential is, to do this at as low a temperature as possible.

It is within the province of this bulletin to say something of ptomaine poisoning in its relation to canned goods.

The general acceptance of the term "ptomaine" is erroneously construed as being poisons occurring in canned goods and other foods; but it is a broader term, covering all bacterial excretions,

and as all material is more or less acted upon by organisms, it necessarily contains ptomaines.

There are certain varieties of micro-organisms, which produce *poisonous* ptomaines, either while acting alone on material, or associated with others, but they are in the minority, and produce poisons under certain conditions only.

The poisonous ptomaines are toxins, which produce toxic effects when taken into the system with food; these toxic ptomaines or tox-albumens are elaborated by the activities of certain bacteria, while they are growing and feeding upon plant or animal matter, either raw or cooked, and are designated principally by the material upon which the organisms are acting. After these basic alkaloids are once produced they are not easily destroyed by subsequent cooking, hence the danger of partial decomposition of food material, either before it has been canned, or after removal from the can.

There are organisms such as bacillus of cholera, bacillus of tetanus and bacillus of typhoid fever, which form toxic ptomaines while growing in the human body as parasites, but they are not known to produce the same poisons in food material.

These organisms are the specific cause of the diseases mentioned and gain entrance to the human body through various means, but rarely through the ingestion of cooked, or canned food.

Then there are several varieties of putrefactive organisms which produce ptomaine poison in canned meat, head cheese, fresh pork, fish and other animal matter, both raw and cooked.

If when growing in head cheese, or in canned meat which has been long out of the can, these organisms are taken into the stomach of susceptible individuals, the body acts as an incubator, increasing their growth and elaboration of toxine, causing ptomaine poisoning of a more serious character than when only the toxic poison has been taken. Head cheese is particularly conducive to the growth of these germs, because the interstices between the meat are filled with a moist gelatinous substance from pork which seems to favor their growth.

A peculiar feature of ptomaine poisoning is, that the material containing a dangerous amount of the poison, or germs which produce it, show but little or no indication of its presence.

Specimens of pork chops and head cheese received at the laboratory and which were known to have caused severe illness in individuals who partook of them, gave no indications of their con-

taining a dangerous poison nor organisms which produce it, neither by discoloration, odor nor breaking down of tissue, yet the microscopical examinations showed the specimens to be permeated with bacilli.

Just why certain varieties of these organisms infest meat sporadically and not more frequently is but mere conjecture.

The cause of ptomaine poisoning may frequently be traced to carelessness, through the utilization of products which are not marketable owing to partial decomposition.

Ice cream has been known to cause ptomaine poisoning because it has been allowed to melt, and after remaining in that condition for some time, is mixed with fresh material and again frozen. Such economy is dangerous, because during the period which it remains in a melted condition an excellent media is offered for the growth of germs which produce tox-albumens, and the subsequent cooking, or freezing, does not destroy the toxins.

Canners are sometimes unjustly held responsible for goods which cause ptomaine poisoning, when in fact it is the consumer's carelessness in allowing germ action to occur in the material after the can has been opened.

On the other hand, some of the canning establishments should be censured, if not punished, for placing upon the market goods which have been processed a second time.

All canneries sustain a loss of a percentage of their goods through one cause or another, either from insufficient heating, or more frequently from defective cans which are not air-tight. When the can is cooling there is a partial vacuum formed, which draws air into it through the leak, and inoculates the material with organisms; putrefaction or fermentation at once begins, and after a time the cans show evidence of decomposition by the liquids oozing out, or by swelling. The latter also occurs when insufficient heat is used to destroy the spores of organisms previously contained in the material.

By the time the germs have produced enough gas to swell the can, and if they are of certain varieties, sufficient toxic poisons will be produced to render the material dangerous for food.

In some canneries, when cans are noticed to have swelled, they are punctured to allow the gas to escape, then exhausted, sealed and reheated.

The contents of cans which have swelled, should be thrown away and not offered for sale as food.

The regular vent in cans is usually a small puncture in the center of the cap, which in the process of canning is closed with a drop of solder. A can having more than one puncture frequently marks it as having been reprocessed and therefore dangerous.

There are other causes which permit toxic ptomaines to be produced in canned goods for which the canner is not wholly responsible.

Cans with defective tinning, in time become perforated by acids of various kinds which attack the iron, resulting in punctures of microscopic dimensions through which air passes into the can carrying with it micro-organisms, and the result is a putrefaction or fermentation.

Metal poisoning from eating canned goods is sometimes the result of acid bacterial products, fruit and vegetable acids acting upon the tin, or by lead contained in the solder used in making the can.

Muriate of zinc, (solder flux) occasionally finds its way into cans when carelessly used in soldering the cap, and copper sulphate is used by some canners for the purpose of fixing the green color in vegetables.

Preserving Fruit Juices.

This state is rapidly becoming famous for its production of fruit, especially of apples, and wherever apples are raised in abundance, there is always a percentage not marketable; consequently, there are thousands of bushels annually wasted, whereas the utilization of these waste products would go far toward defraying expenses of maintaining the orchard.

There is no more wholesome beverage than sweet cider, but the question of keeping it sweet without the use of preservatives, has prevented its being more generally used, yet this may easily be accomplished as demonstrated by the experimental work which has been done, and is as follows:

Take clean quart bottles, preferably beer bottles, fill them with cider fresh from the press, leaving all of the neck of the bottle empty for an air space; then place the bottles in a steam chest so that the steam when turned on will circulate freely all around them; next, steam or scald with boiling water, good sound corks, and leave them in water until needed; then, fill one bottle with cider, place it in the steam chest close to the top where a hole is provided to admit a long thermometer which passes into the bottle, so that the mercury bulb reaches about the center; the other end extending above the steam chest will show the temperature of the contents of the bottle.

When all the bottles are in place and door closed, steam is turned on and the temperature of the material raised to 160° F., as indicated by the thermometer which may be seen without opening the door.

This heat is maintained for ten minutes after which the bottles are immediately corked, and corks tied down.

After twenty-four hours, the bottles are again heated to the same temperature, and the operation repeated the next day for the third time.

The air space in the neck of the bottle allows for expansion, which prevents bursting of the bottles.

If the bottles are to be stored in an upright position, the corks should be dipped into hot canning wax after heating the last time. If they are laid down, this is not necessary, because the fluid keeps the cork swelled and air-tight.

No particular style of steam chest is necessary—the one used in this work was made with a frame of 2x4 studding, to which was nailed matched lumber 1x3; the door was made of the same material, and of the size of one entire side.

The chest measured 72 inches high, 44 inches wide and 39 inches deep.

Steam was admitted to the chest by a $\frac{3}{4}$ inch pipe passing through the side wall, near the bottom, reaching to about the center; an elbow was placed on the end of the pipe, with the opening down, to distribute the steam by first striking the floor of the chest.

Inside the chest there were three trays with coarse screen wire bottoms, to allow the steam to circulate; it was found necessary to turn on a good head of steam to equalize the temperature throughout the chest.

This treatment will sterilize the cider, or any fruit juice, without changing its flavor, or imparting a cooked taste, and it will keep sweet indefinitely.

If the cider is filtered through felt, or asbestos, in order to remove all suspended matter, the annoyance of having sediment in the bottom of the bottles will be overcome.

It is essential to bottle and sterilize the material as soon as possible after it is taken from the fruit, as there are less yeast cells, and other organisms in it at that time.

After standing twenty-four hours or more before bottling, they will multiply into millions, and not only are there more to destroy, but the enzymes formed during their growth, will not be destroyed by heating, and gradually react on the material, changing its flavor in time.

To do this work on a large scale, it would be advisable to use at least three steam chests, to obviate the necessity of so much handling of the bottles, each chest could remain closed until after the third heating.

For home use, where steam is not available, a wash boiler could be used, it should contain a small amount of water, and be provided with slats to prevent the bottles from touching the bottom; a tightly fitting cover must be used to retain the steam, so that the necks of the bottles will be sterilized.

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March, 1906.

Department of Entomology and Plant Diseases.

Oregon Agricultural Experiment Station.

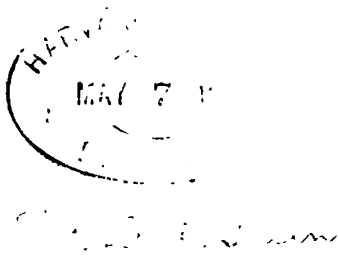
CORVALLIS, OREGON.

..SAN JOSE SCALE..

By A. B. CORDLEY.

**THE BULLETINS OF THIS STATION ARE SENT FREE TO ALL RESIDENTS
OF OREGON WHO REQUEST THEM.**

**1906
Oregon Agricultural College Press
Corvallis, Oregon**



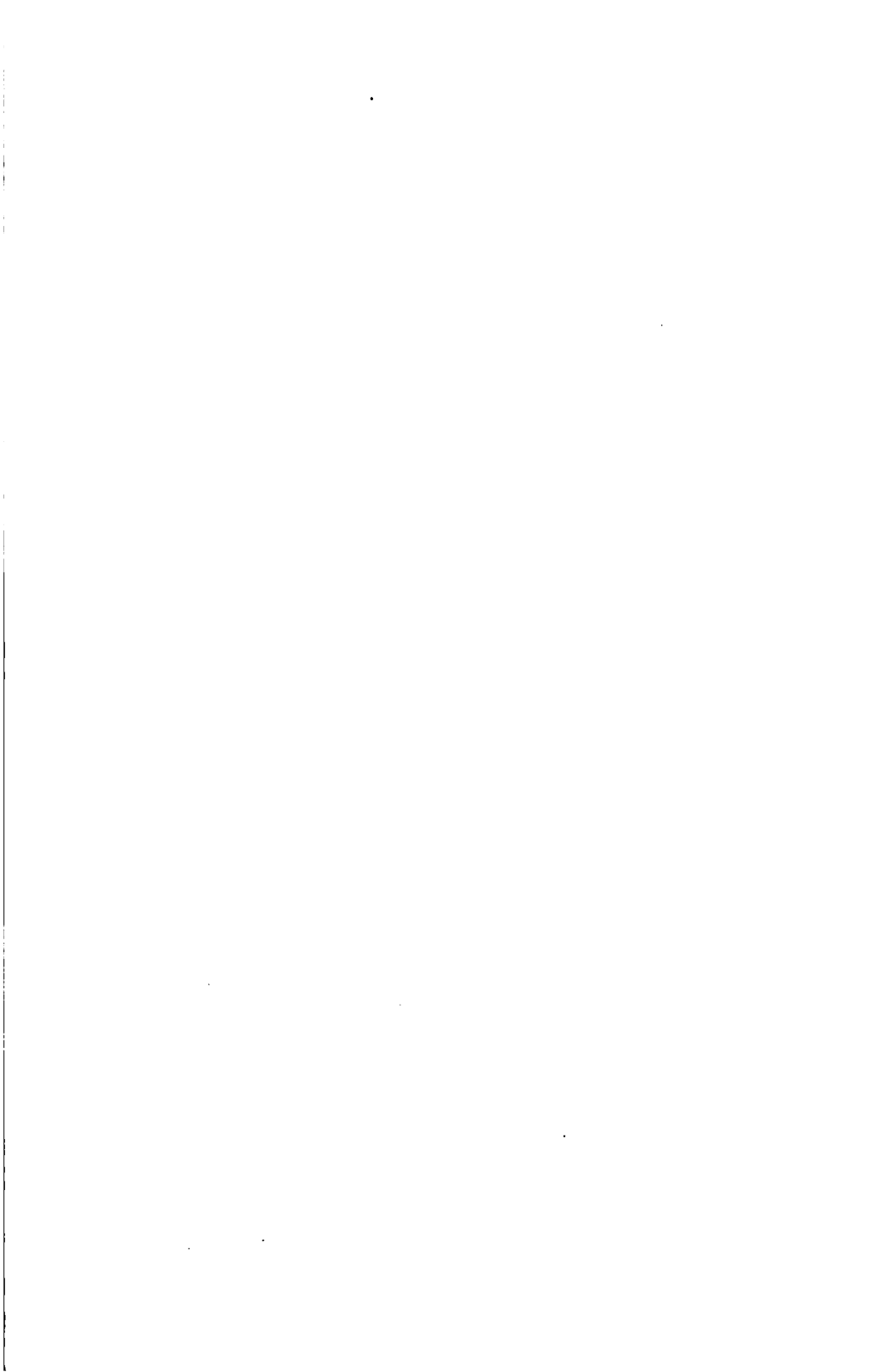
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A SAN JOSÉ SCALE AFFECTED APPLE

THE SAN JOSE SCALE.

The San Jose scale is the most destructive of all pests in neglected orchards. Nevertheless, by intelligent effort it can be more easily controlled than any other first class orchard pest; and when we come to realize that the one annual winter application of the lime, sulphur, salt spray, which is all that is necessary to reduce its ravages to the minimum, is also one of the best general "cleaning up" sprays that has yet been devised, we shall, perhaps, be ready to exclaim with J. H. Hale, the veteran peach grower of Connecticut and Georgia, "Blessed be the San Jose scale." It has compelled us to spray with the lime, sulphur and salt.

One application of lime, sulphur, salt each winter will do more for the neglected orchard than can be done in any other way by the same expenditure of cash and energy. It not only destroys San Jose scale, but it also destroys the branch form of woolly-aphis, the eggs of the green-aphis, the pear-leaf blister mite, the hibernating larvae of the prune twig-miner, probably the hibernating larvae of the bud-moth, together with most other insects which may chance to be wintering upon the trees. It is also a good fungicide. If applied in early winter it is nearly or quite equal to Bordeaux for the second application for apple-tree anthracnose; applied to peach trees just before the buds open in spring it is a preventive of peach-leaf-curl; and applied to apple trees under similar conditions it is a satisfactory substitute for the application of Bordeaux which is usually recommended for that time.

With all its good qualities, however, the lime, sulphur, salt spray is not a cure-all. It does not, so far as known, reduce the number of wormy apples in an orchard, nor can it be used as a substitute for Bordeaux while the trees are in foliage. It is a distinctly winter spray and should be used even in winter only upon deciduous trees.

The San Jose scale is very largely responsible for the present enthusiastic crusade against the old neglected, moss-covered orchards. Everyone is pruning and spraying. Why? To destroy the San Jose scale. Yet I find that a very small percentage of our farmers know what this dreaded thing is which they are so earnestly

endeavoring to destroy. If any other spray than the lime, sulphur and salt were being used, a reaction against all spraying would certainly follow the poor results of so much misdirected energy. By using the lime, sulphur, salt spray beneficial results are almost certain to follow whether the scale be present or not. Nevertheless everyone who grows trees or shrubs should learn to know this destructive little pest and be prepared to combat it, since it may at any time appear upon the ornamentals of the city lot as well as the trees of the old home orchard. Dr. L. O. Howard records it upon the following plants:

LIST OF FOOD PLANTS.

Orchard Fruits.

Pear,
Peach,
Apple,
Plum,
Cherry,
Rocky Mountain Dwarf
Cherry,
Persimmon,
Quince,
Flowering Quince.

Small Fruits.

Strawberry.

Bush Fruits.

Raspberry,
Gooseberry,
Grape,
Currant,
Flowering Currant,
Black Currant.

Nut Plants.

Almond,
Chestnut,
Pecan,
Black Walnut,
English Walnut,
Japan Walnut.

Miscellaneous Ornamental Plants—Forest and Shade Trees.

Rose,
Hawthorn,
Spirea,
Cotoneaster,
Euonymus,
English Huckleberry,
Linden,
Acacia,
Elm,
Osage Orange,
Alder,
Sumac,
Weeping Willow,
Red Dogwood,
Juneberry,
Laurel.

English Willow,
Golden Willow,
Laurel-leaved Willow,
Milkweed,
Catalpa speciosa,
Lombardy Poplar,
Carolina Poplar,
Golden-leaved Poplar,
Silver Maple,
Cut-leaved Birch,
Mountain Ash,
Japanese Quince,
Actinidia,
Citrus trifoliata,
Snowball,
Loquat,
Akebia.

How to Know the San Jose Scale.

Perhaps the worst feature of an attack by San Jose scale is that, owing to its small size and inconspicuous color, it often remains unnoticed until the tree has been seriously injured or even killed. That the tree lacks vigor may be recognized, but the cause of its unthriftness is overlooked. Yet it is not difficult to detect when one really looks for it. In the early stages of infestation a few scales may be found, usually clustered about the buds of the preceding season's growth, or even on two year old wood. The mature scales are grayish in color, being usually but not always somewhat lighter than the bark to which they are so closely attached. The immature half-grown scales which may be found with the mature ones, are at the present time somewhat darker in color.

The mature females are nearly circular in shape, are approximately one-sixteenth inch in diameter and each is somewhat raised in the centre to form a slight protuberance or nipple which is lighter in color than the rest of the scale. (See Fig. 1). If this scale is carefully examined by means of a small magnifier several concentric circles may be observed between the nipple and the outside edge; and if it be carefully raised with the point of a pin or a knife there will be revealed a minute bright yellow object, the insect itself. (See Fig. 3).

On badly infested plants the young scales settle wherever there is room to insert a beak into the bark and as they increase in size they become much crowded and overlapped and have the appearance of a gray scurvy deposit on the bark. The natural color of the bark is obscured and the infested plant appears as though coated with fine ash-colored bran. If the thumb-nail or other object is rubbed over this scurvy covering, thereby crushing the insects beneath the scales, a moist or oily appearance is produced and numerous scales will be overturned and many of the little yellow insects be revealed.

During the early stages of an attack very few if any of the scales will settle upon the leaves or fruit. Later both may be attacked. Upon the leaves, especially of the prune and peach, the young scales may be found on both surfaces, and more particularly clustered along the midrib. Each scale produces a minute purple spot. Upon purple prunes, red apples, etc., the scales appear only as minute gray specks usually clustered about the cavities at either

end, but upon the yellow fruits like pears, peaches, and the yellow plums and apples, each scale produces a bright, reddish discoloration (See Frontispiece). If badly infested, the fruit, particularly of pears and apples, become much pitted, distorted in shape, cracked and unmarketable. (See Fig. 2.)

For the benefit of fruit inspectors in particular, it should be noted that reddish discolorations upon yellow fruits are not always caused by San Jose scale. Upon yellow apples and particularly upon peaches very similar spots are produced by attacks of certain minute fungi. Hence, such spots should not in themselves be taken as proof of infestation by the scale. This can be determined definitely only by a careful examination and the actual detection of the scale. The presence of such blotches may well arouse suspicion of the presence of San Jose scale and should challenge a careful examination alike by growers, buyers and inspector; so also should the presence of dead and shriveled leaves upon the trees in mid-winter invite examination for although their presence is not proof of the presence of the scale it is evidence that the vitality of the tree has been seriously impaired by some cause and in regions where San Jose scale is prevalent that cause in a vast majority of instances is the scale.

Development of San Jose Scale.

On the approach of winter scales of various ages and sizes may be found upon infested trees. A very large proportion especially of the immature scales usually perishes during the winter but at the present writing, March 10, practically all are still alive. We may expect, therefore, with normal conditions for the remainder of the season, to witness a very decided increase in scale infestation during the coming summer.

Fig. 1 shows a mature female surrounded by numerous half-grown individuals. The male scales are not circular but somewhat elongate. If one removes one of the large circular scales the little yellow object thereby revealed is a mature female. Under a moderate power of the microscope she proves to be a nearly circular, yellow, sack-like body with long, slender, bristle-like mouth parts. (See Fig. 3.) An examination of the male shows him to be more elongate and to possess the rudiments of legs, wings, eyes, antennae, etc. (See Fig. 4) The females live and die beneath their scales—never leaving them; but in April the males molt for the last time and soon thereafter

emerge from under their scales as minute active creatures with fully developed wings. (See Fig. 5). After mating the males die.

In May, possibly earlier under favorable conditions, the females begin to give birth to living young and may continue to produce for six weeks or longer. The young are minute, light orange-yellow, active creatures with eyes, bristle-like mouth parts, two antennae or feelers, and six legs. (See Fig. 6). After emerging from under the protecting scale of the parent each wanders over the surface of bark, fruit or leaf until a suitable situation is found when the legs and antennae are folded beneath the body, the bristle-like beak is slowly worked through the outer bark into the living tissues beneath, from which it draws its sustenance. At any time during the summer months hundreds of these little pests may be seen, even with the unaided eye, as they crawl about over the bark or fruit of infested trees.

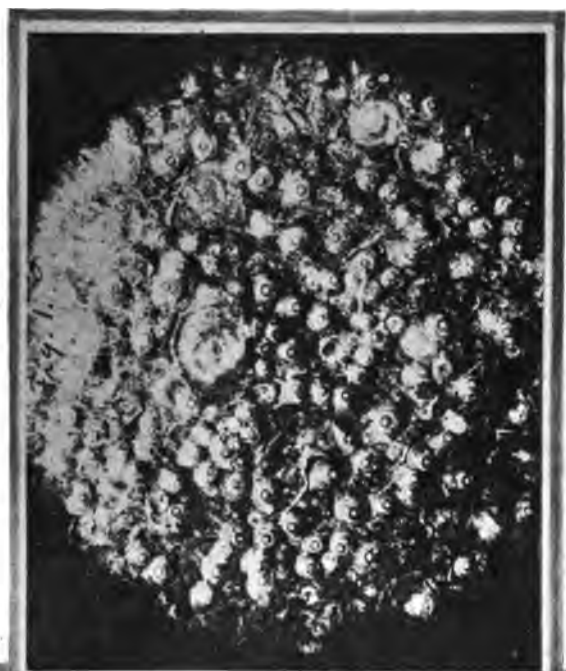
Even before the young insect has attached itself to the bark the secretion of the scale has begun. At first it consists only of a fluffy white mass of fine, waxy threads which for the first day or so of its existence causes the young San Jose scale to appear as a minute downy white speck upon the bark. As these filaments become more abundant they become fused into a more and more compact scale and assume a yellowish color. Later the young scale-insect molts several times during its growth and the fully developed scale is thus made up of fused wax filaments and the several molted skins.

Each female of the over-wintering generation is capable under favorable conditions of producing approximately one hundred young. In the course of but one month these reach maturity and the females begin to produce another generation. There are thus produced some four or five generations during the entire season. Under supposedly favorable conditions single females of the later generations have been observed to produce approximately six hundred young. Basing their estimates upon breeding cage observations, Dr. Howard and Mr. Pergande have shown that it would be possible under the most favorable conditions for the progeny of a single female to reach the astonishing number of 3,216,080,400 individuals in a single season. Should each of these scales reach the largest size, one-tenth of an inch, and were they all placed side by side touching each other in all directions there would be enough of them to cover approximately five acres of surface. It is almost needless

to add that in the intense struggle for existance of organism with organism and with climatic conditions such an astonishing rate of multiplication is not even approximated under natural conditions. Nevertheless, when one realizes the enormous rapidity with which this pest multiplies it is no longer a surprise that *careless* work in spraying fails to give satisfactory results. A few females here and there upon very small portions of the tree which have not been reached by the spray may during a single season completely reinfest that tree. Satisfactory results are obtained only by the most thorough work. Every square inch of surface of trunk, limbs, branches and twigs should be thoroughly covered. By far the most common cause of unsatisfactory results is the failure of those who spray to do thorough work.

How the San Jose Scale Spreads.

Since the female scale is motionless, and permanently attached throughout life to the branch on which it feeds, it is often asked how is it that the San Jose scale can spread from tree to tree, orchard to orchard, and even for larger distances? It is only during the first few hours of its existence that one of these little pests can emigrate, and observation has shown that even then it is incapable by its own efforts of getting more than a few feet at most from the tree on which it was born. But birds and bees and other insects make good airships for the little creatures, and no doubt many a young scale has crawled upon the foot of a bird or upon some larger insect and thereon voyaged to the distant realm of another tree or orchard. No doubt also strong gusts of wind often tear them loose from the bark on which they are crawling and waft them to the branches of neighboring trees. These are provisions of nature for distributing the species. Through the channels of trade they are carried long distances, even from continent to continent upon infested nursery stock, cuttings, etc., and probably to a lesser extent upon infested fruit. Buds and scions carelessly taken from an infested tree may transmit the pest to the orchard in which they are placed or may infest an entire block of trees in some nursery and thence be distributed to many orchards. It is also probable that many are carried about upon the hands and clothing of the men who prune the trees or pick the fruit or otherwise work about the orchards.









By such means has the scale been brought from China, its native home, to San Jose, Calif., whence in thirty-five years it has spread to practically all the fruit-growing states in the Union and to various foreign countries.

Remedies.

There is but one remedy yet discovered which need be considered in this state. That is the lime, sulphur, salt spray. In the east, fairly satisfactory results have been obtained by the use of various preparations of kerosene or other petroleum products, but the high price of kerosene makes it impracticable to use it here in any form for spraying purposes except in a very small way. The San Jose scale has probably been present in this state approximately twenty-five years; and for the past fifteen years the lime, sulphur, salt has been the standard spray for destroying it. During the first few years of its use various formulas were employed and to a less extent this is still true, but since December, 1896, when it was first published in the Biennial Report of the State Board of Horticulture, the formula which has come to be known as the Oregon formula has been the standard one in this state.

The Oregon Formula.

This formula was the result of some extensive experiments by the late Emile Schanno of The Dalles, Oregon, and is as follows:

Quicklime	50 pounds
Sulphur	50 pounds
Salt	50 pounds
Water	150 gallons

This may be much simplified by designating it as the 1-1-1-3 formula, *i. e.*, 1 pound of lime, 1 pound of sulphur and 1 pound of salt to each 3 gallons of water. West of the Cascades this formula is more efficient than the 1-1-4 formula which is reported to be satisfactory in the Inland Empire. The function of the salt being problematical, I have in the last edition of my bulletin on Insecticides and Fungicides (No. 75) advised using 25 to 50 pounds of salt rather than the full 50 pounds which was originally recommended. I can not, however, recommend that the salt be left out entirely, as is evident from the results of two season's experiments which are herein recorded.

In preparing this spray it is my plan to put a little water in the bottom of the boiling vat, start the fire, and when the water comes

to a boil pour in the required amount of lime and sulphur. The hot water, together with the heat generated by the slaking lime, will at once set the mass to boiling briskly. This should be kept up for at least an hour, or until the mixture is of a deep blood-red color, and there is but little free sulphur floating upon the surface. The salt can be added at any time since it dissolves readily.

Plate 3 is reproduced from photographs of two simple boiling vats. Fig. 7 is simply a "hog scalding" vat made of "inch and a half" lumber and with galvanized iron bottom. It is 18 inches wide on the bottom, 20 inches wide on top and 10 feet long. The sides should project two or three inches beyond the ends and the galvanized iron of which the bottom is made should project at each end 6 inches beyond the sides and then be turned up and fastened securely thus forming shallow troughs at each end which must be kept filled with water to prevent the ends from burning.

These vats may readily be set up wherever there is a convenient water supply by simply digging a trench of the proper dimensions, placing the vat over it and banking about with earth to prevent the fire from reaching the wooden sides. A better draft is secured by erecting a few feet of stove pipe at the back end. If the vat is to be permanently located it is of course preferable to mount it upon a brick arch. With such an apparatus one can readily prepare the spray as fast as it can be used by a power spraying outfit running two lines of hose.

If one possesses a steam boiler the spray can be most conveniently boiled in a number of barrels or in large wooden vats, the steam being conveyed to the bottom of the barrels or vats. Thus liberated it not only boils the spray but keeps it well stirred the while, thus eliminating much of the drudgery of stirring by hand which is incident to other methods.

Enemies of the San Jose Scale.

At present I can offer no encouragement to those who desire to see the San Jose Scale held in check by its natural enemies. In August, 1903, I received through the courtesy of Dr. L. O. Howard, a small consignment of the Chinese Lady-bird Beetle, *Chilocorus similis*. These were liberated at Jacksonville, Oregon, in an abandoned pear thicket, on the premises of Mayor E. Britt. This thicket was badly infested with scale, Mr. Britt undertook to see that it should not be sprayed or destroyed during the time of the experi-

ment, and strong hopes were entertained that the extremely favorable conditions would result in a flourishing colony from which beetles could later be distributed to other parts of the state. Several months after the beetles were liberated Mr. Britt and Mr. Chas. Meserve succeeded in finding more than twenty of them still alive and apparently in good condition, but by the following July all had apparently perished as a most thorough search by Mr. Meserve and myself failed to reveal any trace of them or their progeny and similar negative results were obtained from another examination the following year.

A closely related native species, *Chilocorus bivulnerus*, has been reported by Mr. A. H. Carson, Horticultural Commissioner for the third district, to have practically exterminated the San Jose Scale from a small but badly infested orchard near Grants Pass. The late Emile Schanno, The Dalles, Oregon, in 1896, sent me a number of specimens of this species, with the report that they were very abundant upon Fir trees, which were infested with a closely related scale, *Aspidiotus abietis*; but no other reports of such habits have been received and I myself have never observed them.

The much smaller, entirely black, native species, *Pentilia misella*, is much more generally distributed and undoubtedly destroys a great many scales but for some reason it does not increase rapidly enough to keep pace with the increase of the scale, which appears, likewise, to be true of the three or four internal parasites which have been reared from San Jose Scale from various parts of the country.

Experiments in 1904 and 1905.

Through the liberality of the Southern Pacific Company which furnished free transportation for myself and such machinery and supplies as were necessary for the work, together with the courtesy extended by Mr. S. D. Evans of Umpqua Ferry, who kindly placed a badly infested apple orchard at my disposal, I was enabled in the spring of 1904, to conduct a series of experiments with various remedies for the San Jose Scale, which a lack of funds would otherwise have made impossible. The following spring, 1905, I was permitted through the courtesy of the Manager, Mr. Robert Johnson, to repeat most of these experiments in the 160 acre prune orchard of the Benton County Prune Co. Since the work of the second season was largely a check upon that of the first, both will be considered together. In 1904, the work was delayed by almost constant rains

and was not finished until April 10, when neighboring prune orchards were in full bloom and the leaves on some of the earliest apple trees were just unfolding. In 1905 spraying began on Feb. 27 and lasted until about the middle of March.

In neither case was any attempt made to determine the exact per cent. of the overwintering scales which was destroyed by the various sprays since it was thought that the large variation in the relative number of dead and living scales normally present on unsprayed trees would render such estimates misleading and that more reliable and practical results could be obtained by examining the trees during the summer and fall to observe the degree to which they had become reinfested and to what extent the fruit was rendered unmarketable; for after all growers will judge the efficiency of a spray largely by the quality of the fruit. Unfortunately, however, this method of estimating the relative value of the different sprays was to a certain extent disappointing, by reason of the fact that both sprayed and unsprayed trees failed to produce more than an insignificant amount of fruit. However, by examination of the leaves and new growth, on trees which had been the worst infested, results were obtained which it is believed represent very closely the relative value of the different mixtures.

Experiment No. 1. Dunne's Solid Spray No. 1.

Dunne's solid sprays, prepared by David M. Dunne & Co., Portland, Oregon, are said to be prepared from strictly firstclass material and in conformity with the formulas which have been recommended by the State Board of Horticulture. No. 1 is a solid preparation of the lime, sulphur, salt spray and came to us in boxes weighing approximately 100 pounds into which it had evidently been poured while warm and then allowed to solidify.

(1904) Dissolved 200 pounds in 200 gallons of water by boiling. Could see no difference between it and No. 2. Color was such as to indicate presence of copper sulphate. Probably through mistake No. 2 was shipped for No. 1. Was prepared and placed in spraying tank on afternoon of April 4. Rained; not used until 48 hours later but still warm. Leaves on four trees the size of "squirrel's ears." On remainder of trees buds still closed. July 19, 1904, nearly every apple badly spotted by scale—not efficient.

The results in 1905 were more satisfactory but not quite equal to those obtained by standard formulas.

Experiment No. 2. Dunne's Solid Spray No. 2.

This is similar to No. 1, except that copper sulphate is used in place of the salt. It was prepared in the same manner and used at the same strength as No. 1.

(1904) Not efficient but slightly better than No. 1. Most of the fruit badly spotted.

(1905) Many living scales on new growth.

Experiment No. 3. Caustic Soda.

(1904) Dissolved 50 pounds in 50 gallons of water, then diluted to 200 gallons. Very easily prepared but disagreeable to use. Every drop that strikes ones hands or face burns severely. Men declared they would not work for five dollars a day if required to use it.

July 19, not at all efficient; fruit badly spotted.

(1905) Used 20 pounds to 100 gallons of water; also 30 pounds to 100 gallons, but results unsatisfactory. Many living scales on new growth.

Experiment 4. Lime-Sulphur.

(1904) Lime 50 pounds, sulphur 50 pounds, water 150 gallons. Slaked the lime in hot water in boiling vat. While slaking added sulphur, covered with water and simmered for six hours. Still considerable uncombined sulphur.

July 19, fairly efficient. Only an occasional apple with a few scales.

Experiment 5. Lime, Sulphur, Caustic Soda.

Lime 50 pounds, sulphur 50 pounds, caustic soda 24 pounds, water 150 gallons. Slaked lime and added sulphur. After boiling from slaking lime had ceased added caustic soda. This produced a vigorous boiling which continued for nearly 30 minutes. Allowed to stand one and one-half hours, then diluted to 150 gallons.

July 19, almost as efficient as No. 4. Fruit slightly more spotted.

Experiment No. 6. Lime, Sulphur, Copper Sulphate.

Lime 50 pounds, sulphur 50 pounds, copper sulphate 15 pounds, water 150 gallons. Slaked lime, added sulphur, covered with water and boiled two hours. Added copper sulphate crystals and kept over fire 5 hours longer, during which time it boiled vigorously for about 1 hour. Sulphur almost completely combined. In the bottom of the vat there appeared to be considerable more sediment, consisting of fine "shotty" pellets than when salt is used.

July 19, apparently not quite so efficient as No. 4 and 5. Difference very slight.

Experiment No. 7. Lime, Sulphur.

(1904) Same as No. 4, but boiled more thoroughly.

July 19, a very few spotted apples, but only on branches which were evidently not thoroughly sprayed. Very efficient.

(1905) Results obtained with lime, sulphur alone were not so satisfactory. Young scales became quite abundant on leaves and young growth during summer.

Experiment No. 8. Lime, Sulphur, Salt.

(1904) Same as No. 7, except that 50 pounds of salt was added after lime and sulphur had been boiled for 2 hours.

July 19, very efficient. A very few infected apples.

(1905) Very efficient. Leaves and young growth almost absolutely free from scale and no living scales to be found on sprayed wood.

Experiment No. 9. Lime, Sulphur, Salt.

(1904) Prepared same as No. 8, but only one-half as strong.

July 19, most of the apples spotted.

Experiment No. 10. Good's Whale-Oil Soap No. 10.

(1904) This is a semi-fluid whale-oil soap, which dissolves very readily by stirring, even in cold water. For use 50 pounds were dissolved in 25 gallons of water.

July 19, not efficient, every apple badly infested.

Experiment No. 11. Con-Sol.

(1905) This was furnished us by the American Horticultural Distributing Co. of Martinsburg, W. Va., through their agents the Portland Seed Co., Portland, Ore. In a circular letter it is stated that "Our product is a concentrated solution of lime, sulphur and salt, prepared by a process discovered by a German chemist, combining electricity and metallic mercury in extracting the product called Con-Sol, which has proven to be a destroyer of the San Jose Scale." I was advised that it had given good results in the east when used in the proportions of 1 of Con-Sol to 40 of water, but was asked to try the effect of stronger solutions. I used it upon infested prune trees March 1, in the proportion of 1 to 20. Not at all effi-

cient. Many living scales both upon sprayed wood and upon leaves and young growth.

It will be observed that in none of the above experiments were the scales completely eradicated. This is hardly surprising when one considers that the trees, particularly the apple trees were badly infested and had not been pruned for several years. This does not effect the results however, so far as the relative value of the different sprays is concerned, which show that for the two season's work the best results were obtained with the standard lime, sulphur and salt formula. The same formula but with the salt omitted gave practically as good results in 1904, but was not so efficient in 1905.

A. B. CORDLEY.

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Bulletin No. 89.

June, 1906.

Department of Agriculture.

Oregon Agricultural Experiment Station.

CORVALLIS, OREGON.

Part I. Efficiency of Cream Separators Under Farm Conditions.

A THESIS BY IRA P. WHITNEY.

Part II. Dairy School Cream Separator Tests.

BY F. L. KENT.

THE BULLETINS OF THIS STATION ARE SENT FREE TO ALL RESIDENTS
OF OREGON WHO REQUEST THEM.

1906
Oregon Agricultural College Press
Corvallis, Oregon

The separators in the section of the country where the samples were collected were mostly of two makes; but enough machines of other makes were included to give a general idea of the efficiency of all the leading makes of machines, and also to give a somewhat reliable comparison of the different machines.

2. HISTORY OF THE DEVELOPMENT OF THE CREAM SEPARATOR.

The first record we have of centrifugal force being employed in the separation of cream from milk was in 1859 when Professor Fuchs of Germany suggested its use for the testing of the richness of milk by swinging tubes containing samples of milk. He was followed by other experimenters who developed his idea to some extent, but nothing of any practical value was found until the year 1876 when a new stage of progress was reached.

At the request of Professor Segelcke and others, Mr. Winstrup, a well-known engineer, undertook the problem of developing a more practical separator. His machine which was used first in 1876 marked a new era in the progress of development of the separator. He adopted a large drum revolving about a shaft at its own axis. The walls were made solid and wings were fastened to the wall, extending toward the center to compel the milk to travel with the machine. The drum was partially filled with milk, and as soon as started the milk would be thrown to the outer wall by the centrifugal force, leaving an empty space about the center of the cylinder for the cream to collect. After revolving the drum for some time valves were opened in the outer wall through which the skim milk escaped. As soon as the skim milk was out, the valves were closed, the motion stopped, the cream removed, and a new supply of milk poured into the machine and treated in the same way. This system had its disadvantages however, for a great deal of time was lost in stopping and starting the drum.

To overcome this, Houston and Thompson, of Philadelphia, discovered a method for the continuous separation of cream from milk, and made application for a patent on October 29, 1877. On April 5, 1881, after several interferences, the patent was granted.

Two new continuous flow machines appeared in Scandinavia in 1878 and 1879. These machines were the Neilson and Peterson, a Danish invention, and the DeLaval, a Swedish invention. Shortly after this, several other continuous flow separators appeared, both in Europe and in America, and since that time the development has been quite rapid.

The first separators had large, clumsy bowls made very heavy, to insure safety, and with no internal parts to aid in separation. In 1890, however, discs or pans were introduced and in the drum-shaped bowls they were found very effective, greatly increasing the capacity of the machines, decreasing at the same time the size of the bowls. The speed required in operating was also considerably lessened. Since that time many changes have been made in different machines to make them more efficient, but the principle remains about the same.

3. THE CREAM SEPARATOR ON THE FARM AND CONDITIONS REGARDING ITS EFFICIENCY.

For a number of years after the invention of the continuous flow centrifugal separators we find that they were used only in the factories, being considered too complicated and dangerous for unskilled persons to operate.

The first hand separators were introduced into America in 1887. They were of the hollow bowl type, and were clumsy, hard running, and had a very small capacity. They were improved along the same

lines as the factory machine, and in the latter part of the last century became quite popular on the farm.

When the benefits to be derived from them became known they spread quite rapidly over certain sections of the United States. In other sections, however, they were discouraged, because leading butter makers claimed that as good butter could not be made from cream separated on the farms, as that separated in the factory. This was found to be mostly due, however, to the poor care the cream received at the hands of the farmers, and to the length of time it was kept before delivering at the factory.

It was, however, a difficult task to educate some of the farmers to give their cream the proper care, and in some of the leading dairy sections the farm separator was practically unknown until within the last two or three years.

As the farmers became better educated, they saw the advantage of having their skim milk to feed while still warm from the cow, and also the time and labor that could be saved by doing away with the daily trip to the creamery, and where the separator was most strongly opposed, we find it rapidly gaining in popularity. The butter maker must now turn his attention to educating the farmer how best to care for his cream, instead of using his influence to keep the separator out of the country.

A. ITS ABILITY TO REMOVE ALL OF THE FAT FROM THE MILK.

A great many things should be taken into account in studying the efficiency of a separator, but the most important one is its ability thoroughly to remove all of the fat from the milk. A machine might be perfect in every other way and be of no practical value to the farmer if it did not skim close.

While the early makes of separators were a great improvement over all the gravity systems which had been in vogue, yet they left considerable fat in the milk, and many of the improvements that have been made were for the purpose of securing more thorough separation.

(1) GENERAL EFFICIENCY OF ALL MAKES.

The data collected in this investigation have been, for the most part, regarding the efficiency of separators in removing all of the fat from the milk, but note was also made of the capacity, age, repairs which had been necessary, and the number of revolutions of the crank per minute of each machine from which samples were taken.

The data collected are given in table A, a general table covering all of the work done.

When possible samples taken under spring conditions were from the same machines that the samples under fall conditions were taken.

Under fall conditions, samples were secured from twenty-one different machines, the average test of the cream was 34 per cent and of the skim milk .045 per cent, while under spring conditions, samples were secured from twenty-six different machines, fourteen of them being the same machines from which samples had been secured in the fall. The average of the cream tests was 34 per cent, and of the skim milk, .02 per cent. The whole milk in both cases being about of the same richness.

This thoroughly demonstrates the superiority of the centrifugal separator over the most efficient of the gravity systems, which would, at best, leave from .25 per cent to .50 per cent of fat in the skim milk.

TABLE A. GENERAL TABLE.

Name of Patron.	Kind of Machine	Size.	Capacity per hour.	Age, years.	Speed in number of turns of crank per minute	Tests, Fall conditions			Tests, Spring conditions			Repairs
						Per cent.	Whole milk.	Skim milk.	Per cent.	Whole milk.	Skim milk.	
J. Park.....	DeLaval.....	Humming Bird.....	250	2½	50	37	---	.03	29	3.9	.04	
O. Witham.....	DeLaval.....	Humming Bird.....	250	4½	50	---	---	---	38	3.8	.02	
S. T. Frazier.....	DeLaval.....	Humming Bird.....	250	1	55	---	---	---	44	3.4	.02	
A. C. Bicknell.....	DeLaval.....	Humming Bird.....	250	8	55-60	---	---	---	26	4.4	.08	
G. G. Newton.....	DeLaval.....	Daisy.....	350	2½	52	23.5	3.8	.02	26	4.8	.02	
G. W. Cooper.....	DeLaval.....	Daisy.....	350	2	50	36.5	4.4	.10	29	3.4	.02	
C. S. Bohanan.....	DeLaval.....	Daisy.....	350	2½	50	45	4.2	.12	29	3.4	.02	
A. S. Hulbert.....	DeLaval.....	Daisy.....	350	2½	50	39	4.2	.06	47	4.4	.01	
A. A. Hulbert.....	DeLaval.....	Daisy.....	350	2½	50	31	4.7	.01	37	4.6	.06	
W. J. Hulbert.....	DeLaval.....	Daisy.....	350	2½	50	31	4.7	.01	21.5	4.1	.01	
C. H. LeVee.....	DeLaval.....	Daisy.....	350	2½	50	36	4	.01	34	4.2	.02	
Alex Bayce.....	DeLaval.....	Daisy.....	350	2½	50	---	---	---	34	3.6	No trace	
I. Bryant.....	DeLaval.....	Daisy.....	350	1	50	---	---	---	32	4	.01	
W. K. Taylor.....	DeLaval.....	Alpha Baby No. 1.....	450	8	45	---	---	---	29	3.4	.02	
S. C. Dixon.....	DeLaval.....	Alpha Baby No. 1.....	450	3½	50	30	5.2	.03	29	4.2	.02	
Thos Cooper.....	DeLaval.....	Alpha Baby No. 2.....	600	3½	50	39	4.4	.10	37	4.2	.02	
Chas Harder.....	DeLaval.....	Dairy Turbine.....	1000	1½	6000 rev. of bowl	28	4.5	No trace	---	---	---	
A. C. Miller.....	Sharples Tubular.....	No. 3.....	275	3	44	32	5	.02	35	4.7	.01	
Robt Wylie.....	Sharples Tubular.....	No. 3.....	350	2½	44	32	4.1	.10	27	4.2	.01	
G. Malace.....	Sharples Tubular.....	No. 4.....	350	2½	40-45	35.5	4.5	.02	34.5	4.3	.01	
Mrs M. Smith.....	Sharples Tubular.....	No. 4.....	450	4½	45	24	6.2	.04	22	6.5	.02	
Geo. Linderman.....	Sharples Tubular.....	No. 4.....	450	2 mo.	45	38	---	---	28	5	.01	
E. I. Davis.....	Sharples Tubular.....	No. 4.....	450	2	45	52	4.7	.07	29	3.9	.02	
E. C. Blumhart.....	United States.....	No. 6.....	275	2½	55-58	27	4.2	.05	41	4.2	.02	
G. Taylor.....	United States.....	No. 7.....	220	2	60	39.5	4.5	.04	34	3.6	.02	
H. Ohling.....	Iowa.....	No. 1.....	350	1	60	---	---	---	---	---	---	
Wm. Park.....	American.....	No. 2.....	350	2	60	37	5.1	.02	---	---	---	
I. W. Watts.....	National.....	No. 1.....	425	2½	42-50	28	4.2	.06	---	---	---	
J. I. Hutton.....	Empire.....	No. 3.....	375	2	50	---	---	---	34	4	.08	
A. L. Cator.....	Empire.....	No. 3.....	375	2	60	---	---	---	35	---	.02	
L. F. Gray.....	Simplex.....	No. 1.....	350	1 mo.	55-60	---	---	---	---	---	.01	
Average tests.....												
						34	4.5	.045	34	4.3	.02	

1
New boxing
New boxing

(2) COMPARING THE EFFICIENCY AT DIFFERENT SEASONS OF THE YEAR.

It has been the general opinion that the season of the year and the period of lactation of the cows had something to do with the thoroughness with which the fat could be removed from the milk.

The section of the country from which the samples were collected, gave excellent opportunity to verify this, as most of the herds freshened in the early spring and were well advanced in the period of lactation when the samples under fall conditions were taken. The cows were also on dry feed at this time, while in the spring they had been out on pasture for some time, and most of them had freshened a short time before the samples under spring conditions were taken.

Table A shows that with the average tests of cream being the same, the loss of fat under fall conditions was .025 per cent greater than under spring conditions, or over 100 per cent, while table B shows that, without exception, the separation was more thorough under spring conditions than under fall conditions, several different makes and sizes of machines being considered. The difference was quite marked in some cases.

Table B. Comparing the efficiency at different seasons of the year.

Number of Machines.	Kind.	Size.	Tests, Fall conditions.						Tests, Spring conditions.						Whole milk, Per cent.	
			Cream, Per cent.			Skim milk, Per cent.			Cream, Per cent.			Skim milk, Per cent.				
			Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.		
4.	DeLaval	Humming Bird	45	37	.08	.12	.01	.08	44	29	.04	.02	.02	.08	4	4.2
9	DeLaval	Daisy No. 1	35	30	.06	---	---	.06	47	21.5	34.5	.08	No trace	.02	4	4.2
2	DeLaval	Baby No. 2	39	38	.10	---	---	.10	---	---	---	---	---	.02	4	4.2
1	DeLaval	Dairy Turbine	28	28	---	---	---	---	---	---	---	---	---	.02	4	4.2
1	DeLaval	No. 2	32	---	No trace	---	---	---	---	---	---	---	---	.01	---	---
1	Sharples Tubular	No. 3	---	---	.10	---	---	.10	---	---	---	---	---	.01	---	---
1	Sharples Tubular	No. 4	36	24	.02	.04	.02	.08	42	22	31.5	.02	.01	.01	5.1	4.2
6	Sharples Tubular	No. 6	52	52	.07	---	---	.07	---	---	---	---	---	.02	8	8.9
1	United States	No. 7	27	---	.06	---	---	.06	---	---	---	---	---	.02	---	---
1	United States	No. 7	27	---	.04	---	---	.04	41	34	37.5	.08	.02	.025	---	---
2	Iowa	No. 2	37	---	.02	---	---	.02	---	---	---	---	---	.025	---	---
1	American	No. 1	37	---	.02	---	---	.02	---	---	---	---	---	.025	---	---
1	National	No. 1	37	---	.02	---	---	.02	---	---	---	---	---	.025	---	---
2	Empire	No. 3	26	---	.06	---	---	.06	35	34	34.5	.08	.02	.025	---	4.

(3) COMPARING DIFFERENT SIZES OF MACHINES.

With the improvement of the farm cream separator many different sizes have been put on the market in order to supply the wants of the dairymen having different numbers of cows. The smallest machines put out by any company, and recommended for farmers with from two to six cows, have a capacity of about two hundred and fifty pounds per hour, while the largest ones, generally used by dairymen having from fifty to a hundred, or more, cows, have a capacity of from one thousand to twelve hundred pounds per hour, and are generally driven by belt or turbine power.

In table C is found a list of most of the sizes of farm separators which are generally used, and the average tests of the different sizes of the several makes would tend to show that all sizes are about equally efficient.

Table C. Comparing different sizes of machines (on all tests)

Number of Machines.	Kind.	Sizes.	No of tests made.	Average of all tests.		
				Cream. Per cent.	Skim milk. Per cent.	Whole milk. Per cent.
4	DeLaval	Humming Bird	4	36.5	.03	4.
9	DeLaval	Daisy	16	35.	.035	4.
2	DeLaval	by No. 1	3	29.5	.025	4.4
1	DeLaval	Baby No. 2	2	38	.06	4.3
1	DeLaval	Dairy Turbine	1	28	No trace	4.5
1	Sharples Tubular	No. 2	2	33.5	.015	4.3
1	Sharples Tubular	No. 3	2	29.5	.01	4.1
5	Sharples Tubular	No. 4	7	32	.02	5.2
2	United States	No. 6-7	3	36	.05	4.5
2	Iowa		3	38	.03	4.1
1	All other makes		4	33	.03	4.4
General average of all tests			34		.03	4.4

(4) COMPARING THE DIFFERENT MAKES OF MACHINES.

Here is where the greatest competition has arisen. Every separator company has some special feature about their machine which they claim to be superior to all others, but all companies claim that their machines will remove all the fat to a trace, if properly cared for.

In table D is a comparison of the leading makes from which samples were secured. Enough samples were obtained from the DeLaval and Sharples Tubular machines to form some idea of the value of each regarding thorough separation. Under both fall and spring conditions the Sharples Tubular was ahead, and on an average of all tests it skimmed .01 per cent closer than the DeLaval. The average test of the whole milk separated by the Sharples Tubular was from .50 per cent to .75 per cent higher than that separated by the DeLaval, while the average test of the cream was 3 per cent lower. This may have been the reason for some of the difference.

The tests under both conditions, however, of all the makes of machines from which samples were secured show the Sharples Tubular to be the most efficient in removing all of the fat from the milk.

Table D. Comparing the different makes of machines.

Kind of Machine.	Fall conditions,				Spring conditions,				Summary of fall and spring conditions				
	Number of tests.	Ave. tests.			Number of tests.	Ave. tests.			No. of machines.	Number of tests.	Ave. tests		
		Cream. Per cent.	Skim milk. Per cent.	Whole milk. Per cent.		Cream. Per cent.	Skim milk. Per cent.	Whole milk. Per cent.			Cream. Per cent.	Skim milk. Per cent.	Whole milk. Per cent.
DeLaval.....	11	34.5	.045	4.4	15	34.5	.025	4.1	17	26	34.5	.035	4.2
Sharples Tubular.....	5	32	.04	4.9	6	31.3	.01	4.9	7	11	31.5	.025	4.9
United States.....	2	39.5	.06	4.4	1	29	.02	3.9	2	3	36	.05	4.3
Iowa.....	1	39.5	.04	4.5	2	37.5	.025	3.9	2	3	38	.03	4.1
All other makes.....	2	32.5	.035	4.6	3	34.5	.02	4.	4	5	33	.03	4.4

B. A DISCUSSION REGARDING DURABILITY, POWER REQUIRED FOR OPERATION, SIMPLICITY OF MECHANISM, AND EASE WITH WHICH MACHINES MAY BE KEPT IN A SANITARY CONDITION.

A hand separator may be very efficient in removing all of the fat from milk and yet not be practical. Other questions arise which should be considered in any machine.

The durability of machines varies considerably in the different makes, some of them being serviceable for a while and then breaking down after a short time.

In table A are given the ages of the different machines from which samples were taken. They varied from a few months to four and one-half years. There were only three cases where repairs were necessary. In one Empire machine the bowl became unbalanced and had to be returned to the factory, in a DeLaval "Baby" No. 2 the boxing became worn and had to be replaced, and in a DeLaval "Dairy" steam-turbine machine the steel point bearings became worn and new ones had to be secured. Other than these instances the machines were all in good condition. It may safely be said, however, that the machine which has the fewest bolts and screws to work loose will, other conditions being equal, be the most durable.

No reliable data could be secured from the farmers regarding the power required to operate the hand separators, as each one had become accustomed to his own machine, and generally had no fault to find with it. It is well, however, to give such a question some consideration, for a machine which is used so often should be as easy-running as possible, especially when the work has to be done by hand. One fact was quite noticeable among the farmers, that was the variations in the speed of their machines, even of the same size and make, most of them never taking time to regulate the speed by their watch, but running day after day by guess.

There is a great difference in the mechanism of the various makes of separators. Some are quite simple and easily understood while others are more complicated and are liable to give the unskilled operator considerable trouble at times. This fact should not be lost sight of in selecting a suitable machine, for the more simple the machine, the easier it can be kept in a sanitary condition, and extreme cleanliness is necessary at all times in order that the cream may not become contaminated from the separator.

4. CONCLUSIONS.

1. From the data secured in the investigation it is evident that

the farm cream separator, from the smallest to the largest sizes of the leading makes, is a thoroughly practical machine, and is much more efficient in removing the fat from milk, than any of the gravity methods which had been in use previous to the invention of the centrifugal separator.

2. A comparison of the tests of samples taken under fall conditions when the cows were well advanced in the period of lactation and being fed on dry feed, and under spring conditions when they had been on pasture for some time and most of them having freshened earlier in the spring, shows that the separation was more thorough under spring conditions. (.045 per cent fat in skim milk in fall and .020 in spring).

3. Samples were secured from most of the sizes of separators generally used on the farm and a comparison of their tests shows that all sizes are about equally efficient.

4. Samples were secured from several of the leading makes of separators, and under all conditions the Sharples Tubular machine proved the most efficient, leaving but .025 per cent of fat in the skim milk on an average of eleven tests.

5. No information of any particular value could be secured regarding the durability of the different makes, as the oldest machines from which samples were taken, had been used but four and one-half years and were doing as efficient work as those that had been in use only a few months.

PART II.

DAIRY SCHOOL CREAM SEPARATOR TESTS.

F. L. KENT.

Which separator gives the best results? Which separator do you recommend? These and similar questions are so frequently asked the writer that it is deemed advisable to present herewith some of the results observed in the operation of several of the leading makes of hand-power cream separators during the past four years, particularly during the sessions of the Oregon Agricultural College dairy school.

Through the hearty co-operation of the Oregon representatives of the leading makers of cream separators it has been possible to have for use in this work from six to eight different makes of machines each year, as follows:

American, No. 2. Rated capacity, 450 pounds per hour. Loaned by Mitchell, Lewis & Staver Company, Portland, Oregon. Used in 1903 and 1904.

DeLaval "Baby" No. 1. Rated capacity, 450 pounds per hour. Purchased from DeLaval Dairy Supply Company, San Francisco, California, November, 1902. This machine has been in use in the regular work of the dairy school, and the Experiment Station, without replacement or repairs since its purchase.

DeLaval "Daisy." Rated capacity, 350 pounds per hour. Loaned by DeLaval Dairy Supply Company, Portland, Oregon, January, 1905.

Empire, No. 2. Rated capacity, 450 pounds per hour. Loaned by Empire Cream Separator Company, Bloomfield, New Jersey, October, 1902. Replaced by new model, February, 1904, from Portland Branch Office of Empire Company. Replaced by still later model, December, 1905.

Iowa, No. 3. Rated capacity, 450 pounds per hour. Loaned by Mitchell, Lewis & Staver Company, Portland, Oregon, February, 1904. Replaced with new model, November, 1905.



Simplex No. 1. (New Model)



Sharples Tubular No. 4.

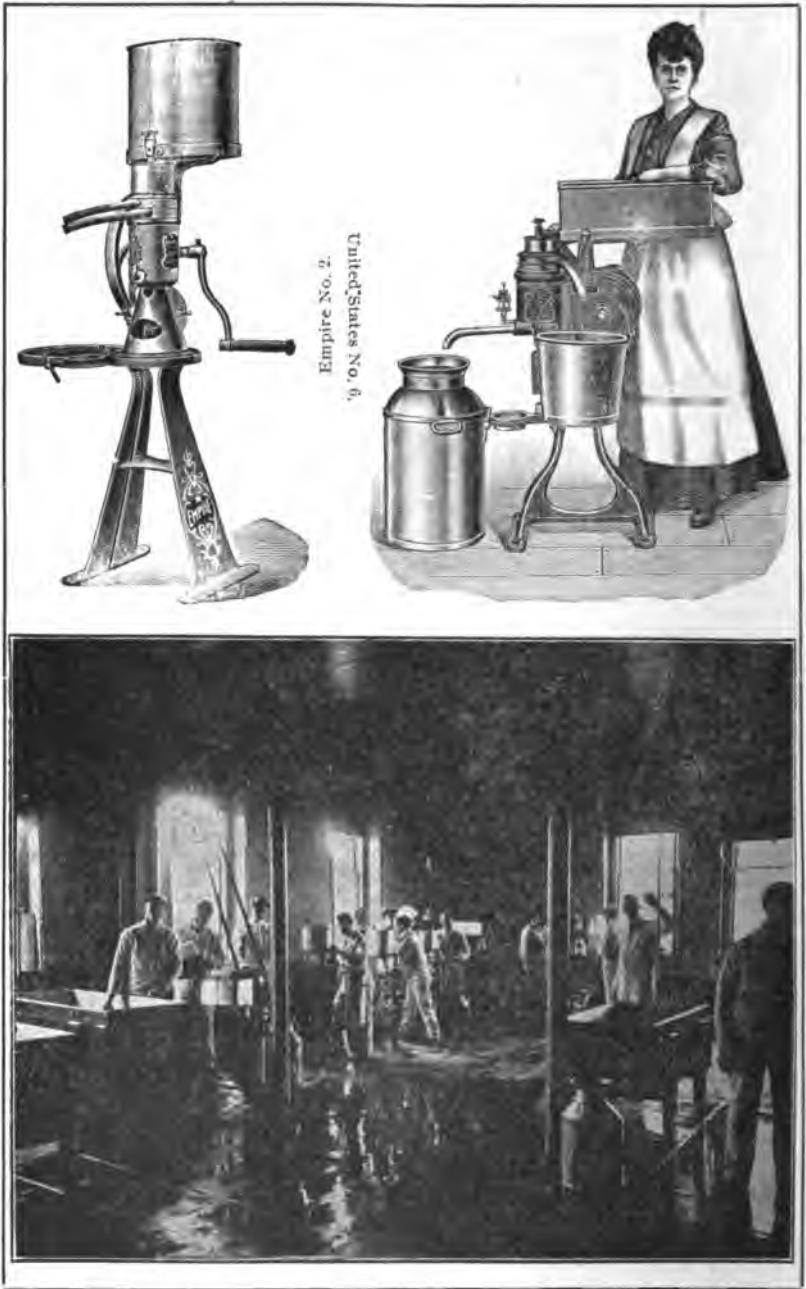


DeLaval "Baby" No. 1. (New Model)



Iowa No. 3. (New Model)

National, No. 1. Rated capacity, 375 pounds per hour. Purchased from R. R. Carlson, Portland, Oregon, November, 1902.



**Omega, No. 3. Rated capacity, 450 to 500 pounds per hour.
 Loaned by R. M. Wade & Company, Portland, Oregon, January, 1906.**

Sharples Tubular, No. 4. Rated capacity, 450 pounds per hour. Purchased from G. W. Kneib, San Francisco, California, October, 1902. Replaced by W. A. Hudelson, Portland, Oregon, with new model, October, 1904. Improved bowl base and ball race placed in new machine, 1905. The interests of the Sharples machines in Oregon are at present looked after by the Chas. H. Lilly Co., Portland, Oregon.

Simplex, No. 1. Rated capacity, 450 pounds per hour. Loaned by Monroe and Shelton, Portland, Oregon, December, 1903. No replacements or repairs.

United States, No. 6. Rated capacity, 450 pounds per hour. Loaned by the Hazelwood Cream Company, Portland, Oregon, October, 1902. Replaced with new model, October, 1904.

In order that all machines might be placed on an equal footing, such sizes were secured as had a rated capacity of 450 pounds per hour, except in the case of the DeLaval "Daisy," and the National No. 1. Such a capacity gives a separation of very nearly one gallon per minute, as a gallon of milk weighs about 8.6 pounds. This size of machine is probably the most practical one for the ordinary user with a herd of seven to ten cows. Its use will enable the separation to be accomplished after each milking in fifteen to twenty minutes. A very common mistake in the purchase of a cream separator is the getting of one of too small capacity. It should be borne in mind that a half hour extra time daily spent in the separation means an aggregate of much valuable time in the course of a year, which would go a long way toward making up the difference in cost between a machine of the above mentioned capacity and the next size smaller. Besides, a long run becomes very tiresome to the operator, and nothing will do more to bring the separator into disfavor among the farm help than a run exceeding a half hour in length. Very little more power is required to operate a machine of 450 pounds capacity per hour than one of one-half that capacity, more or less.

The student tests reported in the following tables were made by the special dairy students after a period of two weeks from the opening of the dairy school for that term, during which time they had become somewhat familiar with the characteristics of each machine, as well as the operation of the Babcock test.

These tests include only those runs which were made under normal conditions, that is, milk at a temperature of 80 degrees or above, cream containing from 25 to 40 per cent butter fat, and machine run at speed recommended in the instruction book for each. The tests were all made during the winter season, January, February, and early March, at which season of the year it is generally supposed that separation is most difficult. It should be stated, however, that a large proportion, possibly a majority, of the cows from which the milk used was obtained, had freshened during the previous fall.

Table 1.—Student Tests, 1903.

Kind of separator.	No. trials.	Ave. temp. milk.	Ave. speed of crank pr. min.	Ave. lbs sep. per hour.	Average percent fat in		
					Milk.	Cream.	Skim milk.
American No. 2	4	86°	48	471	4.1	28.0	.070
DeLaval Baby No. 1	22	85	46	446	4.5	25.0	.021
Empire No. 2	22	86	55.8	464	4.47	25.0	.027
National No. 1	23	85	54	377	4.43	20.3	.030
Sharples Tubular No. 4	22	84	46.8	434	4.5	28.7	.020
United States No. 6	22	82.5	49.0	430	4.6	27.7	.034

Table 2.—Student Tests, 1904.

American No. 2.....	7	82°	48	458	4.6	29.5	.051
DeLaval Baby No. 1.....	13	79	46	467	4.4	29.0	.022
Empire No. 2.....	12	81	55	416	4.4	34.0	.029
Iowa No. 3.....	6	81	60	458	4.5	32.0	.028
National No. 1.....	8	83	54	396	4.4	28.0	.040
Sharples Tubular No. 4.....	12	82.5	47	463	4.3	27.5	.018
Simplex No. 1.....	12	81	51	469	4.4	28.0	.012
United States No. 6.....	11	82	57	463	4.5	24.0	.025

Table 3.—Student Tests, 1905.

DeLaval Baby No. 1.....	4	83	45	460	4.8	34.5	.016
DeLaval Daisy.....	5	80	52	352	4.7	36.0	.015
Empire No. 2.....	6	82.5	56	444	4.7	29.	.029
Iowa No. 3.....	3	84	57	428	4.4	37.	.033
Sharples Tubular No. 4.....	12	82	46.6	484	5.0	34.5	.013
Simplex No. 1.....	11	88	51.4	469	5.1	33.0	.013
United States No. 6.....	6	82.5	56	410	5.1	38.0	.024

Table 4.—Student Tests, 1906.

DeLaval Baby No. 1.....	9	81.4°	45.7	465	4.6	36.0	.023
Empire No. 2.....	8	83	55	445	4.75	31.6	.027
Iowa No. 3.....	6	81.5	60	474	4.2	33.0	.014
Omega No. 3.....	11	82	60	435	4.4	29.3	.041
Sharples Tubular No. 4.....	8	82	45.7	490	4.3	27.6	.013
Simplex No. 1.....	6	83	52	466	4.5	34.6	.013
United States No. 6.....	4	84	58	431	4.9	35.0	.020

Some question as to the accuracy of results as obtained by the student tests having been raised, the writer, assisted by Mr. W. W. Grant, special dairy instructor, carefully supervised the making of five tests for each machine during the season of 1906, making all the records as well as the Babcock tests. The results of these tests are set forth in detail in the following table:

Table V.—Authenticated Separator Tests.

DeLaval Baby, No. 1.

Date 1906	Pounds separated	Temp.	Per cent fat	Capacity per hour	Speed of crank per minute	Per cent fat in cream	Per cent fat in skim milk
February 5.....	134	82	4.8	460	47	40.0	.02
6.....	143	85	4.9	464	46	40.0	.015
9.....	59	78	4.3	444	46	26.0	.02
16.....	80	84	4.7	457	46	28.0	.015
March 2.....	146	86	4.5	480	45	29.0	.015
Average.....				461	46	32.6	.017

Empire, No. 2.

February 7.....	139	85	5.0	450	56	35.0	.025
12.....	131	86	4.7	462	55	39.0	.02
14.....	121	85	5.0	454	57	31.0	.015
18.....	131	86	4.5	462	56	30.0	.02
March 3.....	136	85	4.8	456	56	30.0	.02
Average.....				456.8	56	33.0	.02

Iowa, No. 3.

February 2.....	67	81	5.2	447	56	38.0	.015
5.....	136	82	4.8	466	56	37.0	.015
6.....	168	80	4.2	480	56	33.0	.01
March 12.....	112	85	4.0	480	60	34.0	.01
12.....	123	84	4.8	480	60	40.0	.01
Average.....				474.6	57.6	36.4	.012

Omega, No. 3.

February 6.....	132	80	4.8	420	60	29.0	.04
13.....	131	84	4.6	436	62	33.0	.04
13.....	172	84	4.1	448	62	35.0	.04
14.....	134	83	4.9	446	61	27.0	.02
March 7.....	136	85	4.6	432	62	29.0	.025
Average.....				436.4	61.4	30.6	.033

Sharples Tubular, No. 4.

February 3.....	142	81	4.6	501	48	25.0	.015
5.....	104	83	5.3	482	47	34.0	.01
7.....	107	84	4.7	494	48	30.0	.01
10.....	134	85	4.7	480	45	35.0	.015
23.....	126	85	4.7	480	45	45.0	.015
Average.....				487.4	46.6	33.8	.013

Simplex, No. 1.

February 2.....	122	80	4.6	480	56	34.0	.01
9.....	134	85	4.6	478	52	35.0	.01
13.....	122	84	4.8	466	52	35.0	.015
16.....	137	84	4.8	480	52	36.0	.01
March 8.....	138	85	4.5	478	52	39.0	.01
Average.....				474.4	52.8	35.6	.011

United States, No. 6.

February 2.....	69	80	5.2	438	60	40.0	.02
9.....	115	90	5.0	445	58	31.0	.02
12.....	154	84	5.1	440	61	35.0	.02
March 5.....	115	88	4.6	432	60	33.0	.015
5.....	150	85	4.4	432	60	31.0	.02
Average.....				437.4	59.8	34.0	.019

From the foregoing table it will be seen that a high degree of efficiency is possessed by all the machines tested. Comparing the machine showing the least average loss of fat in the skim milk (.012 per cent) with the one showing the highest (.033 per cent) it is evident that it would be necessary to separate about five thousand pounds of milk to cause a difference of one pound of fat lost in the skim milk from the two machines.

While the function of a cream separator is primarily to remove the cream from the milk, there are certain other features in connection with its use which should be considered, such as durability, power required to operate, convenience of operation, ease of cleaning, etc. Information bearing on some of these points may be gathered from the illustrations shown at the close of Part I and from the following table:

In order to accommodate both the size of the farmer's herd and his purse, cream separators are made in a variety of sizes and sold at prices according to capacity, but not directly in proportion. The smallest sizes are recommended for herds of from two to five cows, while the largest sizes are used with herds of forty, fifty, or more, cows. Usually, however, with a herd of thirty or more cows it will be advisable to use some form of power other than hand power, and for this purpose the turbine machines are particularly well adapted,

Table VI.—Speed, Weight and Size of Bowl.

Kind of Separator.	Revs. crank per min.	No. rev. of bowl each rev. crank.	Speed of bowl per min.	Weight of bowl.		Size of bowl.	
				Empty.	Filled.	Length	Diam.
DeLaval Baby No. 1.....	45	157	7.065 revs.	13lbs2oz	14lbs4oz	7.6 in.	4.2 in.
Empire No. 2.....	55	182	10.010 "	8 " 8 "	9 " 15 "	9.1 "	3.7 "
Iowa No. 8.....	60	202	12.120 "	7 " 6 "	8 " 9 "	8.5 "	3.4 "
Omega No. 8.....	60	144	8.640 "	9 " 5 "	12 " 3 "	9.1 "	4.3 "
Sharples Tubular No. 4.....	45	369	16.605 "	6 " 5 "	7 " 13 "	20.0 "	2.3 "
Simplex No. 1.....	50	158	7.900 "	10 " 10 "	11 " 10 "	7.0 "	4.3 "
United States.....	60	170	10.200 "	10 " 14 "	13 " 12 "	9.5 "	4.5 "

for they are operated without the use of an engine, taking the steam direct from a boiler. Boilers suitable for this purpose can be secured for about fifty dollars, are easily and cheaply operated, and furnish steam for cleaning the separator and other dairy utensils, a feature of the dairy work too often neglected. Sizes, capacities, and prices of the leading makes of cream separators are given in the following table:

Sizes, Capacities and Prices, June 1, 1906.

Kind and size.	Capacity.	Price.
DE LAVAL:		
Humming Bird.....	300 pounds per hour.....	\$ 70.00
Daisy.....	400 " ".....	85.00
Baby No. 1.....	500 " ".....	100.00
Baby No. 2.....	700 " ".....	125.00
Baby No. 3.....	1200 " ".....	200.00
Dairy Steam Turbine.....	1200 " ".....	225.00
15 per cent discount on above prices for cash.		
EMPIRE:		
No. 0.....	175 pounds per hour.....	\$ 60.00
No. 1 A.....	350 " ".....	70.00
No. 1 B.....	450 " ".....	85.00
No. 2 B.....	600 " ".....	100.00
No. 4 B.....	800 " ".....	125.00
No. 4 B (Turbine).....	800 " ".....	150.00
No. 6 B.....	1000 " ".....	150.00
No. 6 B (Turbine).....	1000 " ".....	175.00
IOWA:		
No. 1.....	250 to 300 pounds per hour.....	\$ 55.00
No. 2.....	350 to 400 " ".....	70.00
No. 3.....	450 to 400 " ".....	85.00
No. 4.....	600 to 650 " ".....	100.00
OMEGA:		
No. 1.....	825 pounds per hour.....	\$ 75.00
No. 2.....	400 " ".....	85.00
No. 3.....	500 " ".....	100.00
No. 4.....	650 to 700 " ".....	125.00
10 per cent discount on above prices for cash.		
SHARPLES:		
Tubular No. 1.....	200 pounds per hour.....	\$ 40.00
" No. 2.....	300 " ".....	55.00
" No. 3.....	400 " ".....	65.00
" No. 4.....	500 " ".....	80.00
" No. 6.....	700 " ".....	100.00
" No. 9.....	950 " ".....	125.00
" No. 5 (Turbine).....	500 " ".....	Prices on application.
" No. 7 (Turbine).....	700 " ".....	
" No. 10 (Turbine).....	1000 " ".....	
SIMPLEX:		
No. 0.....	250 pounds per hour.....	\$ 75.00
No. 1.....	500 " ".....	85.00
No. 2.....	700 " ".....	100.00
No. 2 1/2.....	1000 " ".....	200.00
No. 2 1/2 (Turbine).....	1200 " ".....	225.00
No. 2 1/2 (Belt).....	1200 " ".....	225.00

UNITED STATES:		
No. 9	150 to 175 pounds per hour	\$ 40.00
No. 8	275 to 300 " "	60.00
No. 7	350 to 400 " "	70.00
No. 6	450 to 500 " "	80.00
No. 5	650 to 700 " "	100.00

Notes and Conclusions.

As separation occurred but once daily, the night's milk had to be heated always before separation. But careful tests did not show that the fat lost in the skim milk was any greater in the night's than in the morning's milk.

In the absence of dynamometer tests of the power required, it may be said, in general, that the higher the speed of the crank required per minute, the greater the amount of power necessary. The Empire and Simplex machines may be given as exceptions, as they appear to require no more power for a crank speed of 50 to 55 revolutions than the machines which only require a crank speed of 45 revolutions per minute.

Ease of cleaning is a point made much of in the claims of the makers of some separators, but in the opinion of the writer, under ordinary farm conditions, this difference is not of much importance.

While not indicated in the foregoing tables, there is a wide difference in the ability of the different machines for handling milk under unfavorable conditions, such as a low temperature, or slight sourness. It appears that the machines having the greater number of parts inside the bowl possess the greater ability in this respect.

The different makes of separators each possess some point of superiority, more or less important, over all or most of their rivals. If the writer should be called upon to give his opinion as to what constitutes the leading point of superiority of each of the various machines named in Table V, the statement would be about as follows:

DeLaval: Ability to handle milk under unfavorable conditions.

Empire: Ease of operation.

Iowa: Low down supply can.

Omega: Bowl may be quickly stopped without inconvenience or injury to machine.

Sharples: Low down supply can; simple oiling device.

Simplex: Close skimming; no milk tubes.

United States: Apparent durability.

On the other hand, each machine has certain objectionable features, the most prominent of which in each case, in the opinion of the writer, are as follows:

DeLaval: Large number of parts within the bowl.

Empire: Inability to handle milk under unfavorable conditions.

Iowa: Too low skim milk outlet: exposed bowl.

Omega: Too much power required: exposed bowl.

Sharples: High speed of bowl.

Simplex: Height of supply can.

United States: Large size of bowl.

As has already been indicated, there is no very considerable difference in the closeness of skimming with the different machines. In making a selection, therefore, other points should be considered. In fact the selection of a cream separator is largely a matter of individual preference, the same as in the case of other farm machinery.

Acknowledgment: The writer takes this opportunity of expressing his appreciation of the courtesy extended by the representatives of the various separator manufacturing concerns, in furnishing the cuts for the illustrations appearing in this publication.

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Address JAMES WITHYCOMBE,
Director of Experiment Station, Corvallis, Oregon.

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Bulletin No. 90

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May, 1906

DEPARTMENT OF CHEMISTRY

Oregon Agricultural Experiment Station.

CORVALLIS, OREGON

ACID SOILS



Before testing soil

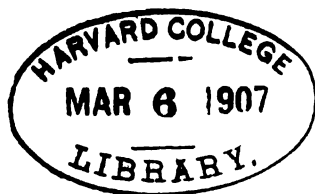


After testing soil

By A. L. KNISELY.

THE BULLETINS OF THIS STATION ARE SENT FREE TO ALL RESIDENTS
OF OREGON WHO REQUEST THEM.

1906
Oregon Agricultural College Press
Corvallis, Oregon



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Bulletin No. 90.

ACID SOILS.

By A. L. KISELY.

SUMMARY.

Eighty tests of soil for acidity were made by farmers in various parts of the State with the following results:

No acidity	8 tests, or 10	per cent of soils examined
Very little acidity	28 tests, or 35	per cent of soils examined
Considerable acidity	31 tests, or 38.75	per cent of soils examined
Strongly acid	13 tests, or 16.25	per cent of soils examined

A majority of the extremely acid soils have been dark loam, muck, beaver-dam or peat, which, usually, are rather poorly drained. In a few cases upland sandy, gravelly clay loams have been found to be very acid.

A majority of the sandy and clay loams examined possess a considerable degree of acidity.

Plantain and sorrel were found to be more common than other weeds on soil containing considerable, or very much acid. These weeds were also quite common on soils containing little or no acid.

Acids in the soil are difficult to leach out.

Acid soils may be improved by applications of quicklime, air-slaked lime, or wood ashes.

The more thoroughly lime is incorporated with the soil, the more effective will be its action on crop production.

Oregon has a great variety of soil and climatic conditions which influence crop production. In some instances the controlling factor seems to be a deficiency of some available element or elements of plant food. In other cases the factor controlling crop production seems to depend almost entirely upon the physical condition of the soil, this being influenced largely by the amount of moisture and humus in the soil and by the thoroughness with which the soil is drained, either naturally or artificially. Some soils are brought to notice which refuse to grow anything. In Western Oregon such soils have been found to be extremely acid. The title page of this Bulletin shows a test made in an extremely acid or sour soil. This soil was obtained from an island in the Columbia River and is composed very largely of decaying organic matter. In such soils the acid is principally organic.

Some soils coming from places in the valleys of the Coast Range have also been found to be extremely acid. These soils are not abundantly supplied with organic matter and the probabilities are that such soils contain more or less free mineral, rather than organic acids.

It was in order to ascertain the prevalence of acid soils in Oregon that a Circular Bulletin was sent to a few of the farmers with the request that it be filled in and returned to the Experiment Station. The following is one of these circular bulletins which was sent to a farmer who tested his soil for acidity, answered the questions and returned the circular to the Experiment Station.

CIRCULAR BULLETIN CONCERNING ACID SOILS IN OREGON.

In some sections of the country certain crops fail without any apparent cause. Injurious conditions of the soil or climate exist and cause these failures.

It is with the idea of sifting out one or more of these injurious causes or conditions that this Circular Bulletin is issued.

Recent investigations have shown that one of the most important causes for the failure of the clover crop is that the soil has become sour or acid. Clover will not thrive on acid soil. The beet plant is also very sensitive to acidity and will not thrive on sour or acid soil, but when the acidity of the soil has been corrected or done away with then clover, beets, etc., will thrive once more.

The potato plant, on the other hand, seems well adapted to acid soils, and when grown on such soils the tubers are

smoother and of better quality than when grown on soils that are not sour.

The Station wishes to determine the extent of the acidity of Oregon soils, and, in carrying out this investigation, the intelligent farmer can be of great assistance to it; in fact he can make the tests for acid soils on his farm and then report the results to the Experiment Station.

HOW TO TEST A SUBSTANCE FOR ACIDITY.—In the accompanying envelope are several pieces of *blue litmus paper*. This is ordinary thin blotting paper that has been dipped in a solution of blue litmus. This blue litmus, when brought in contact with acid, invariably turns *red*. Therefore, whenever blue litmus paper is brought in contact with a moist or wet substance and it turns the paper red, we know that there must be present some acidity.

Caution.—Handle the paper carefully, because it is injured by too much handling with damp, sweaty fingers.

Squeeze a drop of sour apple juice on a piece of the blue litmus paper, if it turns the paper red the juice contains acid. Take some green sorrel leaves and mash them up, and then place the moist leaves against the blue litmus paper, if they turn the paper red the plant contains acid. In fact most of our fruits and plants all contain more or less acid.

HOW TO TEST THE SOIL FOR ACIDITY.—A piece of blue litmus paper is placed in the moist soil for about five minutes and then carefully removed. If the paper has turned reddish in spots then the soil is sour or acid—the more acid there is in the soil, the redder will be the litmus paper.

In making the test, proceed as follows: With a hoe, spade, trowel or some other suitable tool, dig into the earth from two to four inches, so as to get a nice moist surface; then place a piece of the blue litmus paper against this surface and cover all except a half inch of the top of the slip of paper with some of the loose moist earth, and with the hands press it firmly against the paper. The end of the paper is left uncovered, so that it can be easily found when we wish to dig it up.

Let the litmus paper remain buried in the moist earth five minutes, and then carefully remove and dry, care being taken to handle the paper with the fingers as little as possible.

If the paper has reddened and remains so after drying then the soil is acid, and the degree of redness determines, in a measure, the amount of acid in the soil. Make several tests, and after performing them, put the tested slips in the enclosed envelope and return them to the Station, so that we can see the slips of litmus paper after they have been used in making the tests.

If you wish to test different parts of the farm, put the tests from each part of the farm in a separate envelope and write upon it so that we can separate and identify them when we are comparing the results obtained.

To assist us in making a study of the conditions upon your farm and in your locality, please write answer to the following questions in the blank spaces and then return them, together with the envelope containing the litmus paper which you used in testing for acidity, to the Oregon Agricultural Experiment Station, Corvallis.

QUESTIONS TO BE ANSWERED.—I. State the results of the tests made with the litmus paper according to the previous directions. Do you think your soil is acid or not?

We believe there is some acid in our soil.

II. What kind of soil have you on your farm? Gravelly, sandy, sandy loam, clay loam, stiff clay, muck, peat, black or white alkali, etc.

Our soil is variable in different parts of fields, mostly clay loam. Some top soil hard and heavy, some loose and porous and grows nothing.

III. Is your farm mountainous, hilly, rolling or flat?

Rolling.

IV. Is the tested field subject to overflow? Does it hold moisture well or dry out rapidly? Does it bake and become hard or remain loose and porous? In your opinion does the field need draining?

Is not subject to overflow. Holds moisture fairly well. Heavy soil becomes hard; some parts need draining.

V. Do you have any rocky or mineral formations on your farm, if so, what are they called?

Some sand rock at surface in places.

VI. Is much of your farm woodland? What kinds of trees, if any, grew originally on the cleared portion of the farm?

Some oak grew on upland and ash in lowland.

VII. How long has the land been cleared of timber, and how long has the field tested with litmus paper been under cultivation?

Been cleared of timber about twenty-five years (on some parts timber never grew), been in cultivation ever since.

VIII. What crops have been grown mostly? Have you grown one crop continually, or have you practiced a rotation, if so, give the rotation you follow.

Wheat and oats mostly, some cheat on lowland.

IX. Has the field been growing gradually less productive, if so, how do you account for it? Is it due to the way in which the land has been worked, or to a lack of plant-food,

or to weather conditions, or what?

In a general way, give the yields of the field for the last few years.

Soil has diminished in productiveness about as all other soil in the valley. I think it due to straight grain raising and no rotation or rest.

X. Have you any difficulty in growing clover, timothy, beets, etc.? At some time in the past did you grow them more successfully than you now do?

Has not been tried of recent years. Timothy did well on best parts years ago, but never on poor loose soil.

XI. When the clover sod, meadow land, or pasture grasses die out, what weeds and wild grasses usually come in and grow most abundantly?

After timothy run out sorrel took the field, and after a while all left. Fern, red top and mesquite mostly take this land when not in cultivation.

XII. Do you have plantain or sorrel on your farm?

No plantain and very little sorrel.

XIII. Have you ever used any stable manure, commercial fertilizers, land plaster or gypsum, lime, or wood ashes on your land? If so, how much per acre and with what results?

No, not on field.

XIV. Do you save straw for mulching or plowing under, or do you burn the straw in order to get rid of it?

Straw has always been burned or hauled off.

XV. Do you practice summer fallow? Do you think it beneficial or injurious to the crop following such practice?

I have in the past, but will not any more. Don't think it any benefit to crop and injurious to soil.

XVI. Have you any questions to ask concerning your farm operation? Any questions or answers that have been suggested by this Circular Bulletin?

On examining litmus paper I want to know what you think about clover on this soil.

Please sign your name in full and then return the foregoing list of questions and answers to A. L. Knisely, Chemist of the State Agricultural Experiment Station, Corvallis, Oregon.

Name.....	V. M. Woodcock
Postoffice.....	Dusty
County.....	Benton
State.....	Oregon

Eighty of the foregoing circulars were returned to the Experiment Station and the replies have been tabulated in the following pages.

Benton County.

Name.	Postoffice.	Character of farm.	Principle crops grown.	Litmus paper test for acidity.	Principle wild grass and weeds.	General remarks.
David R. Tom.	Alsea.	Flat, sandy loam, loose; dries out rapidly. Formerly covered with fir, alder, oak and willows.	Oats 20 bu., wheat 10 bu., nothing else grown for 20 years.	Very little acid.	Poverty sorrel.	
John Friedrichs.	Blodgett.	Hilly and rolling, clay loam.	Under cultivation 20 years to wheat and oats.	Strongly acid.	Sorrel.	
H. M. Fleming.	Corvallis.	Hilly, clay loam to stiff clay. Originally covered with fir and grub oak.	Wheat for 7 years.	Very strongly acid.	-----	Save all the straw and do not practice summerfallow. Stable manure and wood ashes very beneficial.
George Armstrong.	Corvallis.	Hills and bottom land. Red clay loam on hills, darker in bottoms. Formerly covered with grub oak and ash.	Hill land partly in apples; lower fields, cleared 40 years, grown mostly wheat 20 bu. and oats 25 bu.	Slightly acid.	Wild cheat and other wild grasses. Some sorrel and plantain.	Burn most of straw to get rid of it. Practice occasional summerfallow. Clover seems hard to grow.
Henry L. French.	Corvallis.	Clay and muck, changing to loam on hills. Formerly covered with oak, ash, willow. Soil bakes in spring and needs drainage.	Mostly garden crops with manure; clover and timothy grow naturally; beets never do well.	Slightly acid.	Plantain and sorrel.	Saves all the straw and does not practice summerfallow.
Geo. R. Hall.	Dusty.	Sloping, foothills, east side Coast Range. Bottom land clay loam. Hills are red land, formerly covered with fir, oak, maple and alder in low places. Some boulders and sandstone.	Oats 50 bu., wheat 25 bu., cheat and some grasses.	No acidity in orchard; oat field and pasture slightly acid.	Tar weed, wild oats, poverty grass and sorrel.	Never burn any straw; have plowed some under. Have tried crimson clover with only partial success. Summerfallow occasionally and it makes good crops. Land will bear any amount of stable manure.
V. M. Woodcock.	Dusty.	Fields rolling, clay loam, some heavy, some loose and porous. Sandstone in places; formerly up-	Wheat and oats mostly, with decreasing fields; some crops of cheat, timothy.	Soil quite acid.	Fern, red top, merquite and sorrel take land when not in cultivation.	Straw has always been burned or hauled off. In the past have practiced summerfallow.

Frank L. Howe.	Granger.	land covered with oak, lowland with ash. Cleared about 25 years ago.	Part upland rolling, part flat, clay loam. Up-land formerly grew oak. Cleared about 50 years. Lowland overflows.	Wheat 25 bu. per a. in 1899; last year not worth cutting. Oats and hay.	Upland no acid; low-land slightly acid.	Wild grasses and sorrel.	and Burn most of straw. Do not summerfallow much. Tried clover with good results.
Cecil Coote.	Summit.	Flat, narrow valley. Red gravelly loam. Under cultivation 15 years. Originally grew cherry, vine maple and buck bush.	Red Oats 10 bu. per a. and grass. Vetch and clover will not grow. Mesquite grows with partial success.	Very acid.	Sorrel rank.	very Feed straw to cattle. Have to summerfallow every three years to kill sorrel.	

Clackamas County.

F. H. Renoud.	Canby.	Flat. Fields 1 and 2 sandy loam, field 3 clay loam; 1 and 2 cleared 15 years, 3 cleared 40 years ago. Original timber, yellow fir. Soil dries out rapidly and bakes.	Wheat, oats and potatoes, also corn, vetch and clover. Field No. 1 fails; fields 2 and 3 fair crop.	Field 1 quite acid; field 2 slightly acid; field 3 slightly acid.	Fern, wild blue grass.	Beets will not grow; clover seems to be starting fairly well. Return all straw to land. Summerfallow seems beneficial, but prefer to sow and plow under.
Geo. A. Steel.	Oregon City.	Slightly rolling, flat; clay loam. Originally covered with fir. Cleared 12 to 15 years ago. Under cultivation 9 or 10 years.	Part is orchard with a few crops of potatoes; rest of farm wheat 15 bu., oats 30 to 40 bu. per a.	very Not much plantain or field sorrel.		Clover grows with fair results. Use straw for mulching or plowing under. Have never summerfallowed.

Clatsop County.

Aug. Jurha.	Warrenton.	Hilly with gulches; loam underlain with blue clay; under this sort of vegetation. Formerly covered with	clay Potatoes, turnips, car-rots, strawberries and grass.	Uncleared land quite acid; cultivated land quite acid.	Velvet grass, sorrel.	Have no difficulty in growing clover or timothy. Beets do not succeed well.
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hemlock and spruce.
Cleared about 11 years.

Columbia County.

J. C. Johnson.	Saupepoose.	Table land, rolling, clay loam, loose and porous. Upland formerly covered with fir. Cleared about 13 years ago.	Rotation of grain 40 bu.; clover 4 to 5 tons, corn 20 tons silage, potatoes 200 sacks per a.	Virgin soil not acid; cultivated soil slightly acid.	Some dock, plantain and sorrel, but not much	Clover does well for two years. Use land plaster on clover. Use all the straw for feed and bedding; save manure.
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Coos County.

J. H. Schroeder.	Arago.	Slightly rolling, bench land gravelly; bottom land sandy and clay loam. Bench land, fir and grub oak; bottom land, myrtle, maple, ash, alder, crab apple. Cleared 28 years.	Corn 6 to 7 tons, oats 25 bu. per a.	Considerable acidity	Plantain, sorrel, fern, tar weed, dog fennel.	Land seems much injured by use of manure. Use all the straw about the barn. Timothy does no good. Beets poor. No thorough test with clover.
Alexander Stauff.	Arago.	Nearly flat, gradual slope. Potatoes and hay. Lower portion overflows; sandy loam to clay loam. Fir, myrtle, maple and ash. Cleared off from 5 to 30 years ago.	Potatoes and hay.	Soil strongly acid.	Plantain and sorrel.	Save the straw. Beets fail to do well. Clover dies out. Timothy does fairly well.
Charles E. Getty.	Empire.	Upland hilly, lowland flat; sandy loam to muck. Part is underlaid with sandstone hardpan 1 to 4 ft. below surface. Trees consist of fir, spruce, hemlock, cedar, alder. Land cleared from 8 to 8 years.	Potatoes, fair yield, and truck gardening.	Muck land very acid; upland all slightly acid except field which had lime, which shows little or no acid.	Sorrel and plantain very luxuriant, fern smartweed, chickweed and elkweed	Have difficulty in growing beets, on part of farm clover does fairly well but is scattering.
Victor Stauff.	Marshfield.	Creek bottom land, sandy loam with some clay. Under cultivation about 28 years.	Oats, potatoes 225 bu., clover hay 3 tons per a.	Part of clover field only slightly acid; rest of land very acid.	Wild grasses where clover dies out.	Oats have been grown mostly for hay.

T. M. Collier.	Marshallfield.	Formerly alders. Third of farm is bottom land, sandy peat, rest is bench land, clay loam. Parts need draining. Bench land cleared 18 years. Grew fir, spruce, alder on bottom land.	Red top hay 1½ tons per a.	Very slight to moderate acidity.	Wild red top, also plantain and sorrel on bench land.	Clover does not flourish; a sort of wild red top runs it out.
David McNair.	Myrtle Point.	Bottom land flat sandy soil. Bench land rolling clay loam. Cleared nearly 30 years of myrtle, ash, maple and willow.	Rotation of wheat, corn, barley, potatoes and clover; excellent yields except that potatoes do not do well 2 years in succession.	Bench land no acid; bottom land slightly acid.	Dog fennel on bench land; not much plantain or sorrel.	On bottom land clover does well for years. Use considerable manure on beet and potato land.

Crook County.

Pilot Butte Co.	Bend.	Desert land.	No acid.				Bunch grass and sage brush.	Not yet under cultivation.
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Douglas County.

Scott Morris.	Ada.	Part hilly with some sandy loam and a little muck land. Some sandstone on the farm. Original growth fir, spruce, hemlock, alder and vine maple. Cleared from 3 to 6 years.	Onions on sandy bottom land 500 bushels per a. Grass grows luxuriantly.	All parts of farm show considerable acidity.	Velvet grass, sorrel and plantain.	On part of the farm have difficulty in growing beets. Use stable manure, rate 4 tons per acre, with good results.
G. W. Woolley.	Drain.	Level bottom land, part sandy loam, part black clay loam. Lower portion subject to overflow and needs draining. Cleared 18 years of fir, cedar, maple, alder and willow. Rolling red gravelly creek bottom, some	Mixed grasses, clover and timothy grow to perfection, cuts 2 tons per acre.	Not very acid.	Velvet grass, white clover, sorrel and dog fennel.	Have no trouble in growing good garden beets. Use manure and wood ashes with good results.
Watson Davis.	Roseburg.		Formerly wheat and oats; some orchard	Varies from no acid to moderate acidity	One or two wild plantain	Never tried clover.

Wm. D. Prior.	Stephens.	sandy loam; some portions need draining. Part cultivated for 35 years. Formerly grew grub oak.	and vineyard, also chest, corn and vetch. Corn 50 bu., hay 1½ tons per a.	Little or no acid.	and sorrel.	Never tried clover. Alfalfa does not do well. Timothy grows wild. Beets do well when manured.
John Gelder.	Yoncalla.	Part, rolling, part flat, dark clay loam. Bakes at times and needs draining. Cleared about 80 years of oak, laurel and fir.	Wheat 6 to 18 bu., oats 10 to 28 bu. per a.; some corn.	Varies from no acid to moderate acidity	Thistle, dog fennel, sorrel, plantain and tar weed.	Have experimented lately with clover but it has not grown much, only about 2 inches high. Think summer-fallow is a great benefit.

Lane County.

J. W. Walker.	Creswell.	Farm is flat, varying from sandy and clay loam to black adobe, which needs draining. Ash, vine maple and oak formerly grew on the adobe. Cleared from 6 to 40 years.	Wheat on adobe 26 to 6 bu., oats 12 to 30 bu. per acre. Some corn 70 bu. where each hill received ¼ pint hen manure; 35 bu. per a. without the manure.	Little or no acid.	Dog fennel, blue grass, plantain and sorrel.	Have never been successful with clover or beets. Use most of the manure on garden. Feed my straw to cattle.
J. M. Howard.	Junction City.	Principally flat clay loam, some gravel, well drained.	Wheat 18 to 20 bu., oats 40 bu., barley 30 to 35 bu. per a.	No acid to slight acidity.	Dog fennel mostly.	Am just beginning to try clover. Summerfallow some and believe it beneficial. Unfortunately have burned most of my straw.
William Linton.	Pleasant Hill.	Rolling upland, part nearly flat; clay loam, rather heavy in parts; some places need draining. Original growth, oak, fir, maple and hazel. Most of it cleared and cropped.	Wheat 20 to 50 bu., oats 40 to 65 bu. per acre.	Moderate acidity.	Sorrel most troublesome; also some plantain.	Have not tried clover. Grow grain and cut stubble high to plow under. Summerfallow all summer. Burn very little straw. Manure all used on garden and potatoes. Rotation con-

for 60 years.

sists of wheat, oats and summerfallow.

Lincoln County.

Jas. McDonald.	Chitwood.	Mountainous, sandy loam. Cleared about 8 years of vine maple and cascara. Sandstone rock on farm.	Oats and timothy. Only small amount Plantain and sorrel also some clover. acidity. very bad.	Have large crop of oats and hay, but wheat turns yellow and only produces 1/2 crop. Feed the straw and use manure on garden with excellent results. Beets never do well.
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Linn County.

John Macneill.	Albany.	Rolling clay loam; parts of farm need draining. Originally covered with oak. Cleared about 25 years ago.	Wheat, oats and chest, with decreasing yields. acidity.	Considerable sorrel.	Straw has always been burned. Summerfallow and think it beneficial to crop following. Clover grows through higher portions of field. Straw has always been burned. Have summerfallowed at times but prefer a hoed crop.
Thomas Alvin.	Orabtree.	Level, soil inclined to a sticky clay, bakes like brick in summer. Cleared about 45 years of pine, ash and vine maple. Land needs draining.	Wheat and oats, with decreasing yields. acidity.	Dog fennel and colts tail.	Do not summerfallow, and burn no straw. Use considerable manure. Clover does well one or two years. Have no difficulty with clover and it pays to use land plaster.
A. I. Davis.	Orabtree.	Level, clay loam. Cleared about 15 years of fir, oak, ash and maple.	Potatoes 200 bu. per acre. Very slightly acid. acidity.	Wild blue grass and mesquite.	A kind of blue grass, quack grass.
John Meyer.	Orabtree.	River bottom, sandy loam; needs no draining. Land cleared from 10 to 40 years of fir, ash, maple, willow, hazel and oak.	Wheat 15 to 25 bu., oats, corn, chest and clover. acidity.	Tar weed and chest also sorrel and	Clover grows not over 18 inches high. Save all
J. B. Springer.	Holley.	Mountainous foothills of Cascades; brownish	Nursery trees and truck gardening. acidity.		

G. G. Belts.	clay loam, underlaid with sticky yellow clay. Fir, maple, hemlock, cedar cleared off 11 years ago. Farm is stiff clay loam, Wheat, oats and Very acid. chest. Drainage would help. Prairie land cultivate about 50 years.	plantain very bad.	the manure and use it with excellent results.
Rowland.			
Scio.	Farm is rolling and is Wheat 40 to 20 bu. Very little acid ex- gravelly, some black or less, oats 90 to cept in wet portion and some clay loam. 30 bu. or less. of field consid- erable acid. Cleared about 50 years of oak, vine maple, hazel and fir.	Dog fennel, tar weed plantain and sorrel. Blue grass, mesquite, plantain and sorrel.	Summerfallow consider- ably. Used to burn straw but now feed it and plow under. Yield on part of farm not worth cutting last year. Do not summerfallow. Save all the straw and manure. Have no trou- ble with clover, timo- thy or beets.

Marion County.

A. E. Ringo.	Gervais.	Flat, black loam, under- laid with clay subsoil. Prairie land cultivated about 45 years.	Wheat, oats, pota- Considerable acidity toea, corn, clover.	Milk weed, June grass, dog fennel, sorrel and plantain.	Clover does well. Stack straw and let stock eat it. Summerfallow has been the usual practice. No difficulty in growing clover. Do not practice summerfallow. Save the straw to loosen up land.
A. W. Anderson.	Howell.	Rolling prairie, clay loam; some parts need draining. Some parts cleared 35 years of spruce, fir and ash.	Wheat 20 bu. per a.; Varies from no acid Dog fennel and mes- some parts 10 bu to considerable quite. acidity.		
A. D. Erb.	Hubbard.	Flat, sandy loam, part of which needs draining. Cleared of grub oak about 25 years.	Wheat 20 down to 10 Moderate amount Dog fennel, blue grass and sorrel. but per acre, oats acidity. and clover.		Have some difficulty at present growing clover. Save part of straw for feed and bedding; burn the remainder. Do not summerfallow.
E. Hynes.	Laurence.	Slightly rolling, clay loam; parts need drain- ing. Cleared of fir about 10 years.	Wheat 25 bu., oats Moderate amount Mesquite grass, some plantain and sorrel. 35 bu., potatoes 150 acidity. bu. per acre; also some corn.		Save all the straw.
Joseph Hutsby.	Mill City.	Hill land, black and brown loam with parts underlaid with yellow clay subsoil; impervi-	Varies from no acid Some plantain and to a small amount sorrel. acidity.		Part of farm is result of a landslide, is very rich and will grow any kind of garden truck.

K. Jensen.	Salem.	ous and needs draining. Cleared about 15 years of oak, fir, ash, alder and maple. Slightly rolling, black soil. Prairie land cultivated 40 years.	Wheat 18 bu., oats 30 bu. per a., clover hay 3 tons per a.	Moderate acidity.	Mesquite, dog fennel, plantain and sorrel.	Former occupant always burned the straw, I save it for manure. Do not summerfallow.
Chas. R. Duffee.	Shaw.	Clay loam, dipping to east and south. Formerly grew some fir and oak.	Prunes.	Only slightly acid.	Mesquite and sorrel.	
J. E. Ferris.	Shaw.	Rolling, under cultivation about 50 years. Formerly covered with oak and fir.	Wheat and oats from 15 to 20 bu. per a.	Very acid.	Mesquite, dog fennel, sorrel and plantain.	Yield formerly was 40 bu. but has decreased to 15. We burn straw to get it out of way. Have to summerfallow in order to get any grain.
John Sandner.	Stayton.	Hilly, clay loam "Red hill land," loose porous and dries out rapidly. Cultivated 20 years. Was formerly oak and fir timber.	Wheat, oats and summerfallow 40 down to 12 bu. per acre.	Considerable acid.	Chest, plantain, sorrel, tar weed and fern.	Believe that summerfallow is beneficial.
Fred T. Daniel.	Turner.	Mostly level, dark clay loam; needs considerable draining. Cleared about 40 years of oak, ash and balsam.	Wheat and oats.	Very acid.	Mesquite, also some plantain and sorrel.	Have not tried growing clover. Have summerfallowed some. Save straw for bedding.

Tillamook County.

William H. Goyno.	Tillamook.	Flat, black prairie soil, sort of muck. Cultivated from 5 to 25 years. Formerly timbered with spruce, hemlock and alder.	Grass and oats.	Very much acid.	Sorrel and "yellow weed."	Clover does not grow very well. Use all the straw for fodder.
Wm. Maxwell.	Tillamook.	Level, loose black soil, to 7 ft. deep, underlain with gravel. Prairie land cultivated 15 years.	Oats 50 bu., hay 2 1/4 tons per acre.	Part of land very acid.	Sorrel and so-called hawkweed which resembles dandelion.	Clover and timothy do not thrive.
G. M. Watkins.	Tillamook.	Rolling clay loam, loose	Hay and grass about	Very little acid.	Some sorrel and plantain.	Clover does well on the

and porous. Cultivated about 40 years. Formerly spruce timber.

1 1/2 tons per acre.

tain

newer land.

Union County.

J. M. Olark.	La Grande.	Bottom land clay loam, hillside gravelly, low-land needs draining. Prairie land cultivated about 30 years.	Sugar beets 8 tons per acre. Potatoes.	Little or no acid.	Bull thistles, Chinese lettuce and a little sorrel and plantain	Timothy does well, clover a failure.
C. E. Markam.	Hood River.	Rolling, black, sandy loam; some basaltic rock formation. Cultivated about 25 years. Formerly oak and pine.	Wheat for hay 1 1/2 tons per acre, and corn; also straw-berries.	Considerable acidity	Fern and sorrel, some plantain.	Think summerfallow gives the land a rest. Have no trouble growing clover.

Washington County.

John Henry.	Beaverton.	Some heavier dam, also sandy and clay loams. Nearly level, lowland overflows. Much is under-drained. Cleared from 10 to 35 years of fir, pine, oak and hazel.	Upland, grain; on heavier dam soil, horse radish and onions.	From no acid to faintly acid.	Red top, plantain and sorrel.	Have no trouble with clover, timothy or beets.
P. Gebson.	Gaston.	Hilly clay loam; parts need draining. Farm mostly fir, oak, hazel.	Grain 10 to 20 bu., potatoes 40 to 50 bu. per acre.	Very much acid in wet clay soil.	Tar weed and sorrel.	Save all my straw for stock and do not summerfallow.
J. T. Killin.	Greenville.	Flat, black clay loam; draining would help it. Cleared about 15 years of ash.	Timothy.	Considerable acid.	Sorrel.	
Fred S. Wilcox.	Greenville.	Rather level hill land, gravelly loam, some called "shot land." Cleared 8 to 12 years of fir, vine maple and dogwood.	Clover 2 1/2 tons hay, potatoes 400 bu. per acre.	Moderate amount of acid.	of June grass, black-berry vine, sorrel and plantain.	Clover does well, also beets.

Ephraim Wells.	Hillsboro.	Rolling clay loam, some Hay 1 to 2 tons, potash 100 bu. per acre. Cleared 25 to 30 years of fir, oak, ash and willow. Parts of farm need draining.	Moderate amount of Mesquite, pepper grass, French pink, plantain and sorrel.	Do not have much difficulty growing clover.
E. D. Godwin.	Kinton.	Flat, clay loam on stiff clay. Cleared about 15 years of pine, fir.	Tar weed and some plantain and sorrel.	Use land plaster on clover with good results.
Jacob Wunderli.	Middleton.	Hilly. "shot" land. Cleared about 30 years of fir and hazel brush.	Moderate amount of Sorrel, sheepherds pursue, cheat and dog fennel.	Clover generally does well.
O. K. Schmeltzer.	Scholls.	Clay loam, north slope of Chehalis Mt. Formerly covered with fir. Clear 45 years ago.	Sorrel, dog fennel, and some plantain.	Stack all the straw and let cattle run to it; when rotted haul to fields. Do not summerfallow, as it is injurious. No trouble growing clover.
A. P. Todd.	Sherwood.	Rolling clay loam, 12 to 14 ft. deep, called "shot land," contains much iron. Part cleared 55 years ago of heavy fir and hazel undergrowth.	Varies from small Sorrel and some fern. Wheat amount to consider-able acid.	Clover does excellent; have cut over 5 tons cured hay per acre at one cutting. Use 100 lbs. land plaster per acre.
Adam Zinn.	Sherwood.	Rolling, clay loam; benettified by draining. Cleared of heavy fir or 9 years ago.	Moderate amount of sorrel.	Save all the straw. Use 50 lbs. land plaster per acre.

Yamhill County.

R. V. Harris.	Amity.	Rolling red hill land. Formerly grew oak and fir.	Considerable acidity	Sorrel, French pink and wild mustard.	Think former owners practiced wheat, oats and bare summerfallow. I prefer a hoed crop to bare fallow. Clover started well.
C. Loder.	Carlton.	Rolling bottom land sandy loam, hill land clay loam. The land is drained. Cleared	Wheat 20 bu., oats 70 bu. per acre; also grow carrots.	Dog fennel.	Have no trouble growing anything I wish. Use straw for mulching. Summerfallow every

Geo. Schneller.	Charleston.	about 14 years of fir and oak. Rolling, gravelly soil, with some creek bottom. Fir formerly grew on the hill land.	Grain and clover.	Small amount acid. Slightly.	Sorrel and chest.	fourth year; think it beneficial but lose a crop by so doing. Have no trouble with clover when sown in spring on winter wheat.
J. F. Peffer.	Dayton.	Slightly rolling, clay loam; parts need draining. Prairie land cultivated about 25 years.	Wheat 15 bu., oats 80 bu. per acre; some clover.	Varies from small amount to considerable acidity.	Sorrel, some plantain and many wild grasses.	Save all my straw and never summerfallow. Am beginning to grow clover and it does fine. Beets do well.
L. F. Moore.	Dayton.	Partly rolling, clay loam to stiff clay, some black loam. Parts of farm need draining. Cleared about 25 years of fir.	Wheat 12 to 20 bu., corn 20 to 40 bu.; some oats and hay.	Moderate amount acidity.	Sorrel and dog fennel.	Clover grows successfully. Used to burn straw but now save it for mulch. Do not summerfallow.
Dr. A. Mills.	Dundee.	Red hill land, clay loam with some stiff clay; some "shot land." Cleared about 25 years of oak and fir.	Wheat and oats 12 to 18 bu.	Slightly acid.	Sorrel, fern and some wild clovers.	Have practiced wheat oats and summerfallow. Straw is usually burned. No trouble growing clover where tried.
C. A. Wallace.	McMinnville.	Flat, clay loam, partly dark and some "white land," has recently been drained. Cleared some 35 years of oak and fir.	Wheat 20 bu., and oats 80 to 40 bu. per acre.	Both dark clay loam and "white land," very slightly acid.	Sorrel and so-called mare's tail.	Think summerfallow is all right. Am beginning to grow clover.
James A. Lyman.	Springbrook.	South slope Chehalum Mountain, clay loam with perfect drainage. Cleared about 10 years of fir and oak.	Chesham Cherry orchard.	Slightly acid.	Red root and dogbane, with sorrel in spots.	

The preceding tabulations represent 80 replies. In eight cases, or 10 per cent, of the soils examined there was no acidity according to a litmus paper test. In 28 cases, or 35 per cent, of the soils examined very little acidity was found. In 31 cases, or 38.75 per cent, of the soils examined considerable acidity was found, and in 13 cases, or 16.25 per cent, the soil was found to be very acid.

The following table gives the different weeds and grasses reported as growing upon the soils examined:

Principle grasses and weeds found.	8 soils examined contained no acid.	28 soils examined contained very little acid.	31 soils examined contained considerable acid.	13 soils examined contained very much acid.
* Sorrel.....	5	15	24	10
Plantain.....	4	8	15	5
Dog fennel.....	5	3	8	2
Mesquite grass.....	2	5	7	2
Fern.....	0	2	6	1
Tar weed.....	2	0	4	2
Bluegrass.....	1	2	3	0
Cheat.....	0	2	3	0
Redtop.....	1	0	2	0
Red root weed.....	0	1	0	0
Dogbane.....	0	1	0	0
French pink.....	0	0	2	0
Thistle.....	2	0	0	0
Mare's tail.....	0	1	1	0
Wild oat.....	1	0	0	0
Quack grass.....	0	0	1	0
Smartweed.....	0	0	0	1
Elk grass.....	0	0	0	1
Shepherd's purse.....	0	0	1	0
Wild mustard.....	0	0	1	0
Wild clove.....	0	1	0	0
Milkweed.....	0	0	1	0
June grass.....	0	0	2	0
Pepper grass.....	0	0	1	0

* EXPLANATION.—Sorrel was found growing upon 5 of the 8 soils examined which contained no acid; in 15 cases out of the 28 soils examined which contained very little acid; in 24 cases out of the 31 soils examined which contained considerable acid, etc.

Of the eight soils containing no acid, seven were classed as clay loams and one as sandy. Of the 28 soils containing very little acid, 15 were clay loams, eight sandy loams, two black loams, two gravelly loams, and one sandy soil. Of the 31 soils containing considerable acidity, 22 were clay loams, six sandy loams, one gravelly loam, one rather stiff clay, and one so-called black loam. Of the 13 soils found to be strongly acid, seven were clay loams, two were black prairie soils, one red gravelly loam, one sandy loam, one muck, and one beaver dam soil. This last named soil consists very largely of decaying twigs, leaves, etc., the results of the work of beavers in by-gone days.

KIND OF TREES FORMERLY GROWN.—In most instances the farm lands which have been tested for acidity have been cleared of timber and underbrush, either recently or some

40 or 50 years ago. In a few cases the farms were prairie land and so far as the farmer's knowledge extends never grew trees of any kind. From the data which have been sent to the Station the following results have been derived: Fir grew upon 62.5 per cent of the acid-free soils; upon 82.2 per cent of the soils containing very little acid; on 38.7 per cent of the soils containing considerable acid, and upon 46.2 per cent of the very acid soils. Oak grew upon 50 per cent of the acid-free soils, on 67.9 per cent of the slightly acid soils, on 22.6 per cent of the soils containing considerable acid, and upon 30.8 per cent of the very acid soils. Ash grew upon 50 per cent of the acid-free soils, on 17.9 per cent of the slightly acid soils, on 19.4 per cent of the soils containing considerable acidity, and on 15.4 per cent of the strongly acid soils. Spruce grew on 12.5 per cent of the acid-free soil, on 7.1 per cent of the slightly acid soils, on 12.9 per cent of the soils containing considerable acidity, and upon 15.4 per cent of the strongly acid soils. Alder grew upon 12.5 per cent of the acid-free soils, on 21.4 per cent of the slightly acid soils, on 6.5 per cent of soils containing considerable acidity, and on 23.1 per cent of the strongly acid soils. Maple grew upon 37.5 per cent of the acid-free soils, on 32.1 per cent of the slightly acid soils, on 16.1 per cent of the soils containing considerable acidity, and on 15.4 per cent of the strongly acid soils. No hemlock was reported as having grown on the acid-free soil, however, it was reported on 3.6 per cent of the slightly acid soils, on 9.7 of the soils containing considerable acidity, and on 15.4 per cent of the strongly acid soils. Other kinds of trees were reported in a few instances as having grown on the various soils.

EXPERIMENT TO OVERCOME SOIL ACIDITY.—In all cases the acid condition of the soil is due to a lack of basic substances. That these acids are difficultly soluble and leach out of the soil very slowly is proven by the following experiment: In the summer of 1905 boxes were constructed in duplicate and filled with beaver dam soil, which consisted very largely of decaying organic matter. Each box held 25 pounds and was filled in such a manner that the soil had thorough drainage. At the beginning of the experiment this soil was very acid, turning blue litmus paper to a decided red color. The cut on the title page shows to what extent the blue litmus paper was reddened.

Boxes were filled as follows:

Soil with no treatment.

Soil with 1 ton quicklime per acre.

Soil with 2 tons quicklime per acre.

Soil with 4 tons quicklime per acre.

These boxes were then exposed to the weather conditions during the rainy season of 1905-06. During which time the soil in the boxes was frequently drenched and leached out. At the end of the rainy season in May, 1906 (34 inches of rain having fallen) these soils were again tested with litmus paper with the following results:

Soil with no treatment—very acid.

Soil with 1 ton quicklime per acre—quite acid.

Soil with 2 tons quicklime per acre—small amount acidity.

Soil with 4 tons quicklime per acre—no acidity.

In certain experiments that have been conducted, it has been found that less than 3 per cent of the total apparent acidity of the soil is water soluble. This, of course, explains why thorough leaching or drainage does not destroy the acidity of the soil.

APPLICATION OF LIME.—If lime is to be applied to sour soil as a means of overcoming its acidity, the lime should be worked into the soil as thoroughly as possible. Lime applied broadcast upon the surface penetrates the soil very slowly. This fact is emphasized according to experiments by *Veitch, who says, "Although some of the fields examined had received as much as 150 bushels of burned stone lime per acre in the last 20 years, and have often been plowed eight or nine inches, lime as carbonate, bicarbonate or hydrate has not penetrated deeper than 12 inches. A medium loam, limed on the surface only, at the rate of 100 bushels of lime per acre, had not been reduced in acidity below one-half inch from the surface. In co-operative experiments with the Maryland Station sufficient lime was applied to the plowed land in the spring of 1903, before planting corn, to neutralize the total apparent acidity of the soil to a depth of nine inches. This lime received such incorporation with the soil as could be had in the regular operation of preparing the soil for corn and its subsequent cultivation. By the spring of 1904 the soil was still acid in the fourth inch. On the lime plots of the Maryland Station, limed only in 1896, the lime has in no case neutralized the soil below the ninth inch. From this mass of evidence the conclusion seems warranted that for practical farm purposes the neutralizing effect of applied lime is not exerted below the depth to which it is incorporated with the soil during the various processes of preparation and cultivation. Consequently, the more thorough and the deeper these operations are, the better the distribution and the more effective the action of the lime."

ACID SOILS AND CROP PRODUCTION.—Certain crops give

*U. S. Dept. of Agr. Bureau of Chem., Bul. 90, pp. 183-187.

better results upon acid, than upon neutral or alkaline soils. Soils containing a moderate degree of acidity produce potatoes of better quality and less subject to scab than those grown on acid-free soils. Cranberries seem to thrive best upon acid soil. The author has made tests in a field of very rank growing dent corn standing some eight to 10 feet in height and the soil was found to be distinctly acid. Some tests have been made in rank growing clover fields and in some cases a certain degree of acidity has been found.

Notwithstanding these facts the general rule seems to be, according to many experiments, that most of the agricultural plants do best upon soils which contain little or no acid.

The most effective means of overcoming soil acidity is by using quick or stonelime freshly slaked, or wood ashes. Contrary to a popular belief, gypsum or land plaster does not possess the power of neutralizing or destroying soil acidity to any appreciable extent.

In many parts of Western Oregon the present high price of lime makes its use prohibitive for agricultural purposes. We believe that if there is a demand for it, that a cheap grade of lime will be prepared suitable for agricultural purposes.

The Experiment Station is at the present time conducting experiments upon acid soils with commercial fertilizers and lime in various amounts and hopes to publish the results of this work.

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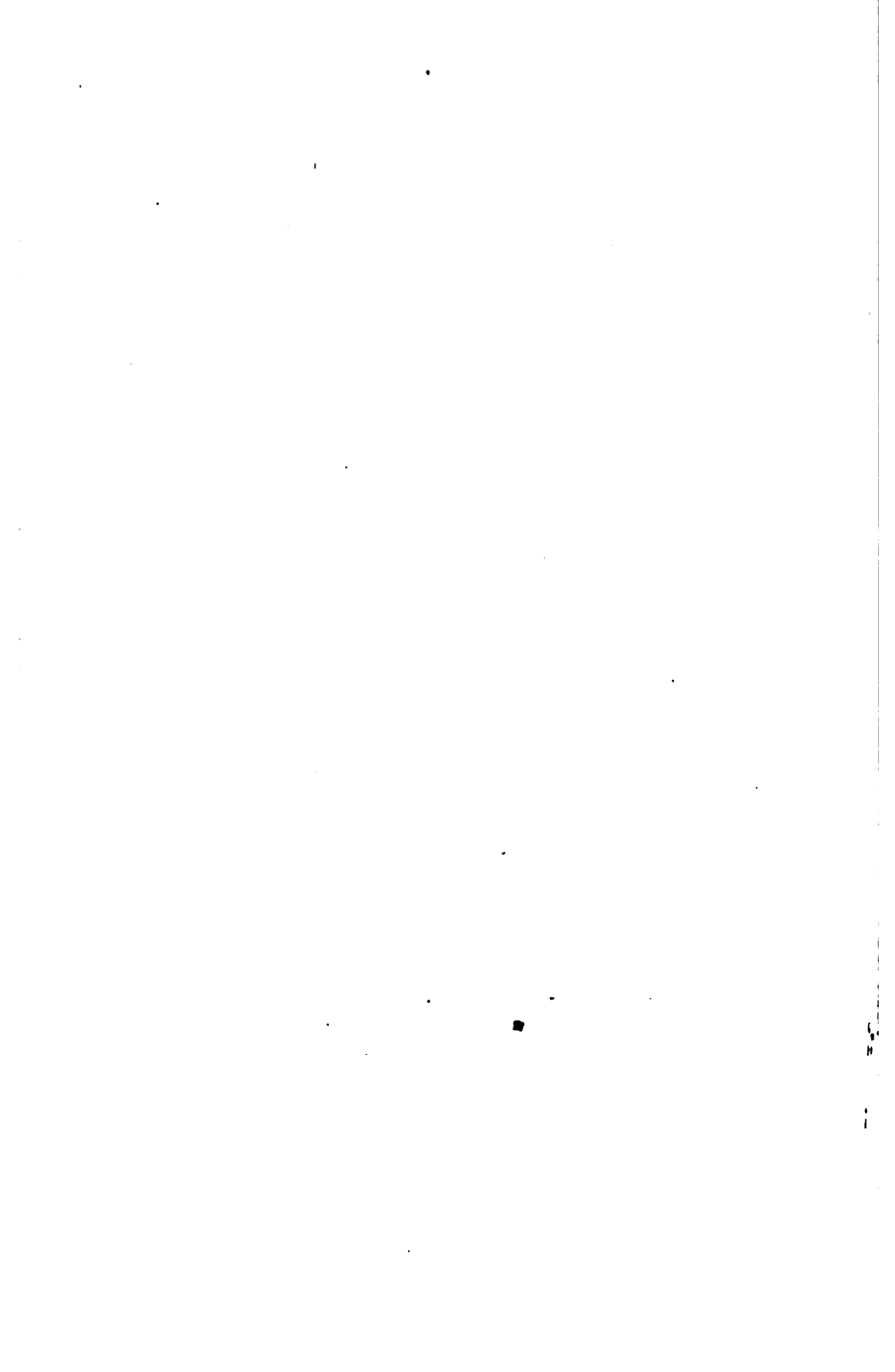
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**Farm Practice with Forage Crops in Western Oregon
and Western Washington.**

BY BYRON HUNTER,

**Assistant Agriculturist, Farm Management Investigations,
U. S. Dept. of Agriculture.**

**Published Jointly by the U. S. Department of Agriculture and the
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Farm Practice With Forage Crops in Western Oregon and Western Washington.

INTRODUCTION.

Although the average methods in farm practice in any region are usually far below the highest possibilities, men are to be found here and there who have worked out the problems of crop production and utilization in a satisfactory manner and who stand out as the most successful farmers in their respective communities. By studying the methods of a large number of such men it is possible to acquire a large amount of valuable information that would require years of patient labor to glean from personal experience. During the three years the writer has had charge of forage plant investigations in the Pacific Northwest, considerable time has been spent in the Willamette Valley and the region of Puget Sound studying the methods of the farmers most successful in growing and handling forage crops. In addition to the information obtained in this detailed study, much has been gleaned during thirty years' residence in the Pacific Northwest, including nine years' residence in the Willamette Valley. This bulletin is a result of this study, and the material herein contained, except as noted in the text, is based almost entirely upon the information obtained in this manner.

For the benefit of the readers of this bulletin not familiar with the condition under which the crops discussed are grown a brief description of the region is given. Although much has been published regarding the superiority of legumes over other plants as soil renovators and food for farm animals, there are many into whose hands this bulletin is likely to fall who do not understand the importance of this group of plants. For this reason a paragraph is given upon the nature of these plants and the methods of their inoculation. For similar reasons the principles underlying hay-making and the use of hay caps are discussed.

DESCRIPTION OF THE REGION.

What is said in these pages is applicable to all that region west of the Cascade Mountains in Oregon and Washington as far south as the upper portion of the Willamette Valley. With the exception of some of the mountainous areas the winters are mild. The summer months are comparatively dry, the nights are cool, and dews

are frequent and heavy. The annual rainfall varies from about 20 inches in a small area where the Strait of San Juan de Fuca joins Puget Sound to more than 100 inches at several points along the Pacific coast. The main body of agricultural land about Puget Sound has an annual rainfall of 30 to 60 inches; that of Willamette Valley 40 to 50 inches.

The average rainfall of this region for six years is shown in the following table:

Average Monthly and Annual Rainfall.

Months	Oregon			Washington		
	McMinnville	Albany	Salem	Olympia	Seattle	Bellingham
	Inches	Inches	Inches	Inches	Inches	Inches
January	7.04	5.48	6.15	8.25	3.98	8.84
February	6.88	6.22	4.17	7.08	4.57	2.69
March	5.71	5.06	4.61	5.17	8.26	2.72
April	8.25	2.41	4.07	4.82	2.38	2.64
May	2.04	1.47	3.42	3.06	2.03	2.52
June	1.15	.74	1.47	2.09	1.87	2.02
July	.58	.57	.28	.65	.82	1.14
August	.81	.82	.65	.68	.68	1.43
September	1.97	1.85	1.94	2.91	2.13	2.26
October	3.39	2.29	3.62	4.24	8.05	2.51
November	10.13	7.44	8.18	10.98	5.77	4.98
December	4.47	6.17	6.62	7.92	5.13	8.85
Yearly	46.87	40.52	45.18	57.25	35.62	32.05

It will be seen that the rainfall is light during summer, heaviest during winter, and quite well distributed throughout the remainder of the year. With its mild winters and abundant rainfall the region as a whole is exceedingly well adapted to forage plant production. Grasses remain green during the entire year, while the clovers, vetches, root crops, rape, and kale, with proper care, all yield abundantly.

In Oregon the Willamette Valley constitutes the major portion of the agricultural land of the region studied. When first brought into cultivation the valley soil was friable, easily tilled, and productive. For years the cereals were practically the only crops grown, and much of the land at the present time is still producing these crops exclusively. The average yield of wheat on such land at the present time is said to be as low as 10 or 12 bushels per acre. Formerly it was much higher. The growing of cereal crops year after year has depleted the soil of much of its humus and rendered it heavy, lifeless, and difficult to work. Applications of barnyard manure and the growing of leguminous crops bring the soil back to

its proper texture and fertility, and since dairying and live-stock production have become such important industries in the valley much of the land is being rapidly restored to its former productiveness.

Western Washington is largely covered with a dense growth of evergreen timber and underbrush. The prairie land is limited and much of it is gravelly and of little agricultural value. Most of the agricultural land was formerly timbered, and it has shown itself eminently adapted to the production of forage crops and various kinds of fruit. Clover has been one of the leading crops for years, and little of the land has been subjected to the exclusive production of cereal crops. As might be expected, therefore, most of the farm land of western Washington is still in a very productive condition.

HAYMAKING.

To make hay of prime quality west of the Cascade Mountains is often a difficult matter. Most of the hay crops, if allowed to mature naturally, are ready to cut during the month of June, while the late spring rains are usually not over until the 1st of July. Thus, hay-making would naturally occur at a time when good weather can not always be relied upon. Even when the weather is fair the nights are cool and dews are frequent and heavy. This difficulty is often partially overcome by pasturing the meadows in the spring until about the 1st of May to retard the development of the crop, so that haymaking will occur after the late spring rains are over.

Conditions Governing Stage at Which Hay Should be Cut.

There are several factors to be considered in determining the proper stage at which a crop should be cut for hay. Chemists tell us that hay made from young growing plants is more digestible and contains more protein per pound than hay made from more mature plants. If hay is cut early the percentage of protein is greater; if cut later, the percentage of protein is less, but the yield of dry matter in pounds is materially increased. As an illustration of this, see the table giving the amount of dry matter in corn at different stages of development. The protein content of hay made from the true grasses, such as timothy or orchard grass, is always low, and the gain in protein per pound from cutting such hay early is always more than counterbalanced by the loss in dry matter. On the other hand, hay made from some of the leguminous plants is said to be too rich for certain classes of animals. Men who have had con-

siderable experience in feeding vetch and alfalfa hay generally agree in saying that either is too strong a feed for horses, especially if cut very green. For this reason hay made from leguminous crops is frequently cut much riper if for horses than when intended for other animals.

Laxative feeding stuffs are undesirable for horses, but not for cows. Green hay is laxative in character, while hay cut in a more mature condition has an opposite tendency. The stage at which hay should be cut, therefore, will depend upon the class of animals for which it is intended.

The number of times a meadow is to be cut during a season is another factor in the time for cutting hay that must not be overlooked. If there is to be but one cutting, the greatest yield will be secured by allowing the crop to become quite well matured before it is cut. When two cuttings are to be made, farmers who have tried the experiment find that the greatest yield is secured by cutting the first crop while it is still green and growing and before the dry season has begun. The ordinary hay plants are not inclined to continue their growth after the first cutting if allowed to stand until their seed is pretty well formed. A delay of only a few days in cutting the first crop of the season often seriously affects the growth of the second.

A statement of the time for cutting will be found under the special discussion of each crop.

Curing Hay.

The best hay is made without rain and with the least possible amount of sunshine. If it were possible to cure hay in the shade, the quality would be much better. The curing of hay is a process of drying and of fermentation. Hot sun tends to stop fermentations which produce hay of good quality.*

From what is said above it is evident that hay should remain in the swath only until dry enough to be raked evenly into windrows; that most of the curing should take place in the cock rather than in the swath or windrow; and that, just as quickly as it is safe to do so, it should be placed in the stack or mow. With fair weather and hot sun, light crops may be raked soon after mowing, often in two or three hours. Heavier crops, especially when green, require more time. When the growth is heavy the swath is often packed so closely to the ground from its own weight and the pressure of the

* W. J. Spillman, in "Farm Grasses of the United States."

wheels of the mower that the use of the tedder is necessary to dry it out evenly.

West of the Cascade Mountains hay is generally put up in permanent cocks, where it remains for a week or ten days. If it is to remain in the field but a short time some farmers cure it quickly by first putting it into small, flat cocks. In about twenty-four hours these are turned over, allowed to air, and then three or four of them are made into one permanent cock. At what stage hay should be cocked is a question upon which there are many opinions. A common rule with farmers is to stack when juice can not be twisted out of a wisp of hay taken from the middle of the cock.

As stated, the common practice in this region is to let hay remain in the field for about a week; in fact, a very large majority of farmers think good hay can be made in no other way under the climatic conditions west of the Cascade Mountains. There are some successful men, however, who put up hay by what has been termed the "rapid process." With good haying weather the method is about as follows: The grass is cut in the afternoon. Being unwilted, the first night's dew does not injure it. If the crop is heavy the tedder is started the next morning as soon as the dew has dried off, and the hay is gone over as many times as possible during the day. Just before evening it is raked and cocked. The hay then stands in the field for two nights and a day until the dew is off the second day. The cocks are then scattered and aired, especially the bottom portions of them, and the hay is hauled to the mow during the day. It thus requires two days from cutting to hauling. The hay is scattered evenly in the mow so that it may all settle alike and exclude as much air as possible, and is salted at the rate of 10 pounds per ton. At night the barn is tightly closed to keep out damp air.

Hay Caps.

When the price of hay is high, it is quite probable that hay caps can be used profitably in making hay west of the Cascade Mountains. The use of caps would prevent the outside of the cocks from becoming too dry, and would thus add to the total weight of cured hay. The quality of the hay would be greatly improved, for it would be practically uniform throughout. The use of caps would also greatly increase the certainty of saving the crop. A farmer in Georgia has used hay caps for ten years. He thinks they materially increase both the quality and the quantity of his hay. Unfortunately there

are at present no hay caps on the market. However, they may be made of light canvas or any strong cotton cloth in sizes to suit. Caps $4\frac{1}{2}$ to 5 feet square, with pegs or weights attached to hold them in place when in use, ought to give satisfactory service. A coat of oil should be applied to one side of the cloth. The caps should always be dried after being used, for they will mold if piled up wet.

THE SILO.

That the silo should have a very general use in western Oregon and western Washington, not only for the preservation of corn but for many other crops as well, ought to be apparent from an understanding of the climatic conditions of the region. As previously stated, most of the hay crops are ready to cut during the month of June, while spring rains frequently continue until about the 1st of July. (See table giving the distribution of rainfall on page 5.) It will thus be seen that haymaking ordinarily occurs at a time when good weather can not always be relied upon. If meadows are pastured during the spring to retard the development of the crop, so that haymaking will occur after the late spring rains are over, the yield of the second crop is usually much lighter, since its growth is confined entirely to the dry season. By the use of the silo, on the other hand, the first crop may be cut for ensilage early in June, even though the weather be unfavorable for haymaking. If cut at this time, while the plants are still growing vigorously, a good second crop will usually mature for hay early in August—the best haying season of the year. A light third crop can be used for pasture or cut for ensilage late in the fall. It is evident, therefore, that the use of the silo will practically insure the saving of the first crop, increase the total yield per acre, and cause the second crop to mature at a time when good haying weather can usually be relied upon.

That all kinds of ensilage should be finely cut may be desirable, but we must not get the idea that it is essential. For years ensilage of the finest quality has been made in western Oregon and western Washington out of whole clover and grass (timothy, English ryegrass, etc). In making ensilage of this kind, however, there are two essentials—an air-tight silo and great care in filling it.

Farmers who use the silo as indicated above agree that the first crop of grass and clover should be cut for ensilage from the 1st to the 15th of June, for the earlier the first crop is cut the greater will be the yield of the second.

Difficulty is usually experienced in raking up freshly cut green grass with an ordinary hayrake. Some farmers avoid this difficulty by cutting with a self-raking reaper or a mower with a buncher attachment. These bunches are then thrown on a wagon by hand. Others cut with an ordinary mower and load from the swath with a hay loader. The heavy green grass often bends the teeth on the elevator bars of the loader. The teeth may be reenforced by nailing blocks of wood on the elevator bars just back of the teeth.

In filling the silo the material must be evenly spread and thoroughly tramped, so that all of the air possible will be excluded. If this is not done much of the ensilage will spoil. Two principal methods were found in use by farmers in filling silos. In the first the freshly cut grass is dropped directly into the silo with a hayfork. Two men in the silo spread the material and tramp it thoroughly, especially around the edges. The center of the silo where the loads from the fork fall requires but little tramping. The second method is to drop the material upon a platform at the top of the silo by means of hay slings or a hayfork. A man upon the platform throws the material into the silo, placing it as best he can. Another man spreads it evenly in the silo and tramps it thoroughly. This is perhaps the safest method, for there is less chance to slight the work. For a few days after the silo has been filled, the settling of the material will allow the addition of two or three loads each day, each load being thoroughly tramped when added. When the filling is completed the top is covered about 1 foot deep with marsh grass or other waste material that will pack closely and exclude the air. This is wetted thoroughly and tramped daily for several days, using about 2 barrels of water at each wetting. The writer has seen ensilage of excellent quality made from whole grass in this way. He has also seen ensilage made by dropping the material into the silo without spreading and tramping that was practically a total loss.

THE NATURE OF LEGUMINOUS PLANTS.

Plants that produce their seed in two-valved pods, such as peas, beans, vetch, and alfalfa, are called legumes. The value of this family of plants as soil renovators has long been recognized, but in just what way they are capable of restoring fertility to the soil has not been understood until recent years. If the roots of a leguminous plant be carefully removed from the soil, little lumps, called nodules or tubercles, will usually be found upon them. These

nodules vary in size with different legumes and may be found alone or in clusters. On the roots of red clover they are about twice as large as the seed of that plant. The nodules are caused by bacteria that are parasitic in the roots.

By the aid of the bacteria living in the nodules, leguminous plants are enabled to assimilate atmospheric nitrogen. Since nitrogen constitutes approximately four-fifths of the atmosphere this family of plants has an inexhaustible supply of this important plant-food element. Other plants can not assimilate the nitrogen of the atmosphere; they can obtain it only from decaying organic matter and from commercial fertilizers containing nitrogen. Chemical analyses show the tissues of leguminous plants to be very rich in nitrogen; hence the value of these plants when plowed under as green manure.

The roots of a clover crop ordinarily contain more nitrogen than the whole crop removes from the soil. As these roots decay, the plant food in them becomes available for other plants. Nitrogen is usually the first element of plant food that needs renewing; hence the great value of leguminous plants as soil renovators.

Generally speaking, the nodules of each kind of legume are caused by certain kinds of bacteria. Thus there is one kind for alfalfa, another for red clover, another for common vetch, and so on. At any rate the nodule-forming bacteria of red clover, for example, have become so accustomed to that plant that they are of little or no value in forming nodules on the roots of most other legumes. If nodule-forming bacteria are not in the soil no nodules will be formed; the failure of leguminous crops is often due to this cause. These bacteria may be artificially supplied in two ways, namely, by means of pure cultures of the bacteria and by transferring soil from one field to another. For further information regarding these two methods, see page 22-23. See also Farmers' Bulletin No. 240, U. S. Department of Agriculture.

FORAGE CROPS.

In the pages that follow, only those crops are discussed that have an important place in the agriculture of the region. What is said regarding methods of seeding, culture, and feeding these crops is based almost entirely upon the farm practice of the region.

Red Clover.

Considering the region as a whole, red clover (*Trifolium pratense*) is easily the leading forage plant west of the Cascade Mountains.

It thrives best on rich, well-drained upland soils. Many of the low lands that are too wet and cold for red clover become adapted to it when properly drained. If allowed to develop naturally, this crop matures for hay early in June. Rains are not infrequent at this season of the year, and it is a common practice to pasture red clover in the spring until about the first of May to retard the development of the crop, so that haymaking will occur during good weather. Red clover begins to grow in the early spring and, unless the soil is very poor and the summer very dry, remains green and furnishes excellent pasture until early in December.

Generally speaking, red clover reaches its highest development on the coast and the region about Puget Sound, where, under favorable conditions, it may be cut three times during the year. To give three crops it must be grown on rich lands and must not be pastured in the early spring. The first crop should be cut for hay or ensilage early in June, the second for hay in August, and the third for ensilage late in the fall. In the Willamette Valley difficulty is often experienced in getting red clover established, especially on land that has produced cereal crops exclusively for years. This difficulty is probably due to the methods of seeding, the dry summers, the poor texture of the soil, the lack of available nitrogen, and possibly the lack of nodule-forming bacteria. Red clover also frequently runs out in a short time. It is believed by farmers that this is due to the ravages of the clover root borer. In spite of these difficulties, however, red clover is one of the leading forage plants of the Willamette Valley. It is not unreasonable to assume that these hindrances to the growth of red clover are largely responsible for the important place that common vetch occupies in the agriculture of western Oregon.

In the Willamette Valley it is a common practice to apply land plaster to clover in the spring, during March and April. From 40 to 60 pounds per acre applied on the surface of the ground in the early spring are said to double the yield of both hay and seed. Land plaster has the same effect when applied to other leguminous crops in this region, but it is essential that it be applied early enough to receive an abundance of rain.

Methods of Sowing.

There are many methods in use for sowing red clover in western Oregon and western Washington, some of which are given below:

(1) *Clover with early-sown winter wheat.*—From 8 to 12 pounds of clover seed per acre are sown in the early fall with winter wheat on land that has been summer fallowed or from which an early cultivated crop has been removed. The seed is usually sown broadcast and covered with a harrow. If the clover fails to catch it can be sown again in the spring, about the first of March.

(2) *Clover with late-sown winter wheat.*—Early in the spring, about the 1st of March, when the ground is heaving slightly from alternate thawing and freezing, from 8 to 10 pounds of clover seed per acre are sown broadcast on late-sown winter wheat. If the ground is dry enough when the clover seed is sown it may be covered with a harrow.

(3) *Clover with spring oats or wheat.*—With this method a good seed bed is essential. The land should be plowed deep in the late fall or winter, and as soon as in good working condition in the spring it should be cultivated until it is in perfect tilth. If the soil is inclined to run together it may be necessary to replot in the spring. Instead of plowing in the fall or winter it may be done in the early spring and the seed bed prepared immediately. After drilling in a full crop of oats or wheat, from 10 to 12 pounds of clover seed per acre are sown and covered with a harrow. In western Washington this is the usual method, with the exception that either timothy, English rye-grass, or orchard grass is usually sown with the grain and clover. On wet land alsike clover often forms a part of the mixture.

(4) *Clover alone.*—When clover is sown alone in the spring the land is plowed early and worked down fine. About the 1st of May it is again thoroughly cultivated to kill weeds and prepare the seed bed. From 10 to 12 pounds of clover seed per acre are then sown and covered by harrowing. The clover may be pastured during the first season, but should not be cropped too closely during the driest part of the summer. This is becoming quite a popular method in the Willamette Valley and very satisfactory stands are secured, but the use of the land is almost lost the first year.

Clover may be sown alone also in the late summer or early autumn. Although this method is seldom used it is probably one of the most satisfactory ways of sowing clover west of the Cascade Mountains. If sown with grain in the fall, clover does not make a crop the next year, but if sown alone in the late summer a full crop is secured the next summer. It is essential, however, that the seed-

ing be done early, for if sown in the late fall it is liable to be winterkilled. Only crops, then, that can be removed early should precede clover sown in this way.

(5) *Clover with rape*.—Sowing clover with rape is a very successful and popular method with many farmers who are engaged in raising sheep and goats. With the land prepared as indicated for sowing clover alone in the spring, from 10 to 12 pounds of clover seed and from 2 to 4 pounds of rape seed per acre are sown broadcast about the 1st of May and covered with a harrow. If the ground is rough and cloddy, it should be finished with a roller. If this mixture is sown on a thoroughly pulverized and compact seed bed, the rape develops rapidly and furnishes excellent pasture for sheep, goats, calves, or swine in from six to eight weeks. The tramping of the animals while feeding during the summer, principally on the rape, forms a dust mulch on the surface of the ground. In this way soil moisture is retained for the use of the clover during the dry summer season. If a hay crop is desired the second season, the rape is killed by pasturing it closely with sheep during the late fall or winter. Sheep eat off the crowns of the plants close to the ground and the rape then dies. If the rape is not killed it will go to seed the next summer, and the stalks will give some trouble in the hay. If the clover is not cropped too closely the first summer, this method gives an excellent stand.

Failures occur frequently, especially in the Willamette Valley, when clover is sown by any one of the first three methods described. With rich, moist soil of good texture and with frequent rains during the summer these methods are usually successful. But with soils that are inclined to puddle and dry out quickly—soils that have produced grain crops exclusively for a number of years—they often give poor results. Under such conditions the grain shades the clover too much, and robs it of the moisture necessary to carry it through the first summer.

The Seed Crop.

Since the first crop of clover is seldom used for seed it is cut for hay or ensilage about the 1st of June to enable the second crop to make a good growth before the dry season begins. Instead of cutting the first crop for hay or ensilage, clover is sometimes pastured until late in May, and the first crop is then used for seed. By mowing the first crop, however, the second one comes on more evenly than when the first is pastured.

When the heads of the seed crop are pretty well dried and are dark-brown in color the clover is cut with a self-raking reaper, or with a mower with a buncher attachment. Bunches of the size of an ordinary wheat bundle are dropped in rows. When the heads are dry enough to powder when rubbed in the hands five or six bunches are thrown together by hand or bunched with a hayrake in the morning when damp with dew. The thrashing is done when possible with a clover huller, and the clover is hauled to the machine in tight-bottomed racks in order that the shattered seed may not be lost.

Alsike Clover.

Alsike clover (*Trifolium hybridum*) has a much wider range of adaptability in western Oregon and western Washington than red clover. It thrives not only on soil adapted to the latter, upland clays and well drained soils, but also on lowland clays, alluvial bottoms, and many soils too wet and cold to grow red clover. Its stems are much finer and more recumbent than those of red clover and its leaves are not so numerous. The yield of the first crop is very satisfactory, but it is disposed to make but little growth after a crop has fully matured for hay. If cut early, however, it is said to make a very satisfactory second growth. A delay of only a few days in the time of cutting the first crop makes a very marked difference in the growth of the second.

Alsike clover makes a very good quality of hay and is well suited to sow with timothy, since these two crops mature at the same time. It is a perennial, stands grazing well, and seems to be much less susceptible to the attacks of the clover root-borer than is red clover. Since alsike clover is so nearly the equal of red clover in nearly every way, it should be given a thorough trial in all localities west of the Cascade Mountains where red clover may have failed. From what is said above it is evident that alsike clover is eminently adapted for sowing on land that is too cold and wet for red clover; in mixtures for permanent pastures; and on forest burns and burnt slashings that are to be used for pasture for several years.

The seed of alsike clover is quite small and five or six pounds per acre will be found sufficient when it is sown alone. With this exception, all that has been said regarding the seeding of red clover applies equally well to alsike clover.

Common Vetch.

This vetch (*Vicia sativa*) is perfectly adapted to conditions west

of the Cascade Mountains in Oregon and Washington and thrives on the poorest of soils. It has been grown in the Willamette Valley for many years, and is rapidly replacing red clover in many localities. It is an annual, leguminous plant of great value as a nitrogen gatherer, as a green manure, and as a soiling, hay, and pasture plant. It is also a very valuable cover crop in orchards when sown in the early fall. It makes excellent ensilage, and dairy cattle prefer the hay to that of red clover. The yield of cured hay is from $1\frac{1}{2}$ to 4 tons per acre. A seed crop yields from 15 to 30 bushels per acre, the yield depending quite largely upon the efficiency with which the seed is saved. A bushel of clean seed weighs a little more than 60 pounds.

Methods of Sowing.

Common vetch stands the winters admirably in western Oregon and western Washington, and is sown in the fall from the last of August to the last of November. It is sown also in the early spring, but fall seeding usually gives the largest yields. The stems of this vetch are not strong, and heavy crops are inclined to flatten out on the ground. When in this fallen condition it soon begins to mold, and is very difficult to harvest. To furnish support for it and keep it up off the ground, a bushel of oats, wheat, or rye and a bushel of vetch per acre are usually sown together. Oat hay, especially for dairy purposes, is usually preferred to that of wheat or rye, and for this reason, oats are usually sown with vetch, winter oats being sown in the fall and spring oats in the spring. It is a common practice with vetch growers to sow winter oats and vetch broadcast in the early fall on land that has raised a spring crop and cover the seed with a disk harrow. If the land is loose and easily worked, this method gives good results, but like most other crops vetch gives much better yields if sown on a well prepared seed bed. If the ground is packed, or if the seeding is done in the spring, the land should be plowed and a good seed bed prepared.

Soiling.

Sown with rye the last of August or early in September, this vetch should be ready for soiling, *i. e.*, feeding green, from the 15th of April to the 1st of May; sown with winter oats or wheat the 1st of October, it should be ready about the 1st of May; sown with winter oats or wheat in the late fall, it should be ready about the 1st of June; sown with oats in February, it should be ready about the

15th of June. When cut in the early spring for soiling, a second crop may be cut or pastured, or the land may be plowed and planted to some other crop.

The Hay Crop.

Since fall sown vetch matures for hay in June, and rains are not infrequent at this season of the year, it is quite a common practice to pasture it in the early spring, March and April, to keep the growth from becoming so heavy that it will fall before it is cut, and to retard its development so that haymaking will occur after the rains are over. If the crop is heavy and falls during bad weather, it is best to make ensilage of it immediately.

When the seeds are just appearing in the first pods, is usually considered the best time to cut vetch for hay. Some cut it earlier than this, while others allow the first seeds to become pretty well matured. If the crop is not too heavy it may be handled in the ordinary way, but it should be put into cocks before the leaves are dry enough to be broken off during the handling. When very heavy it falls more or less, and usually in some prevailing direction. When in this fallen condition the rear of the sickle-bar of the mower is usually raised and the guards tilted down. Some have a man follow the mower with a strong pitchfork, and when the vetch clogs he sticks the tines of the fork into the ground just behind the sickle-bar and pulls the vetch loose.

Others cut vetch in but one direction, the opposite way from that in which it is leaning, driving the mower back idle each trip. Men with forks throw each swath out as it is cut so that the mower can get through without the vetch clogging on the sickle-bar. Another way is to cut a swath and with forks roll it on to the uncut vetch; cut another swath and roll the two cut swaths on to the uncut vetch; cut again and roll the three cut swaths out. This process forms winrows of three swaths each. See Fig. 1.

With the vetch fallen in one prevailing direction, others cut one way only, driving the mower in such manner that the fallen vetch will point forward and away from the direction driven, at an angle of about forty-five degrees. A little experience will enable one to determine the proper angle. When the cutting of a swath is finished, the sickle-bar is raised, and the mower thrown out of gear and driven back on the swath just cut to mash it down and make a path for the shoe of the sickle-bar with the wheel of the mower. With

the sickle-bar raised, the guards tilted down, the vetch lying in the direction indicated, and the last cut swath lapping up on to the uncut vetch and mashed down by driving the empty mower back over it, the inner wheel of the mower, as the next swath is being cut, runs upon the swath just cut and holds it so that the shoe of the sickle-bar slips over with little or no clogging. In this way the swath upon which the wheels of the mower are running is cut in two again and another clean swath is also cut at the same time. Cutting each swath in two makes the handling of the hay much easier. After being cut the hay may be cured and handled in the usual way.

The Seed Crop.

It is very difficult to separate the seeds of wheat or rye from vetch seed, while those of oats and vetch can be separated reasonably well. For a seed crop that is intended for market, therefore,



Fig. 1.—A common method of cutting tangled vetch. The first swath cut is rolled on the uncut vetch after the mower passes again, the double swath is rolled on the uncut vetch; when the mower has cut under this, the triple swath is rolled outward.

oats and vetch are usually sown together in the early fall, about a bushel of each per acre. In the spring they are usually pastured until in April to keep the growth from becoming so rank that it will fall. The vetch then matures in July. The seed matures very

unevenly, the pods burst open when overripe and exposed to the sun, and much of the seed may be lost in this way. The best seed is always produced in the lower pods and the seed crop should be cut when these pods are turning brown and before they have begun to drop their seed.

If the crop stands up well and is not too heavy, it is cut with a binder and shocked immediately. From twelve to fifteen bundles are put in the bottom of the shock and other bundles built on top of this again, letting the butts of the upper bundles come down to the bands of the lower ones. Other bundles are built on top of this again, covering all of the seed pods possible. This prevents the shattering of a great deal of seed, for the pods dry evenly and gradually when not exposed to the sun.

If strictly pure seed is desired, vetch is sometimes sown alone at the rate of 100 to 120 pounds per acre. When thick, it stands up reasonably well. If the seed crop is too heavy to bind, it is cut with a mower. With pitchforks the first cut swath is rolled on to the uncut vetch; another swath is then cut and the two cut swaths rolled on to the uncut vetch; when the third swath is cut the three cut swaths are rolled out. This forms winrows of three swaths each. It is then placed into large cocks immediately and allowed to dry with as little exposure to the sun as possible. This method of cutting and cocking largely prevents the loss of seed from shattering. If cut and raked in the usual way the wheels of the mower, the wheels of the rake, and the tramping of the horses burst many of the ripe pods. As soon as the vetch is dry it should be threshed without delay, with an ordinary threshing machine, hauling it to the machine in tight bottomed racks or spreading canvas over the racks to catch the shattered seed. In threshing, the concaves are removed and blanks having no teeth used instead. The motion of the cylinder is slowed down and plenty of wind turned on. The use of hay caps in curing vetch for seed would greatly increase the yield, especially when it is cut with a mower. The pods on the surface of the cocks become dry and burst before the centers of the cocks have time to cure. In this way a great deal of seed is lost. The caps would protect the pods on the surface of the cock from the direct rays of the sun and permit the whole cock to dry more evenly. See the discussion of hay caps under haymaking.

In growing a seed crop of vetch considerable seed is lost on the ground by the bursting of the pods. If this fallen vetch seed is

plowed under much of it will be covered too deeply to germinate. The amount of oil in the seed is such that it may then lie in the ground for years without decaying, and grow when turned up near the surface by subsequent plowing. In this way it may become a pest in wheat that is grown for market. Land that has grown a seed crop of vetch may be prepared for wheat as follows: Sow oats and vetch broadcast in the fall, without plowing, and cover the seed with a disk harrow. Cut the oats and vetch for hay the next season and pasture the second growth close enough to prevent any seed from maturing. Grow a cultivated crop the next year. The land should then be ready for winter wheat.

Pearl Vetch.

Pearl vetch (*Vicia sativa alba*) has been grown in the Willamette Valley for a number of years, but is comparatively unknown except in the vicinity of New Era, Oregon. It is so much like the common vetch (*Vicia sativa*) that they can not be distinguished except by the color of the seed. The common vetch has a dark-colored, mottled seed, while the seed of pearl vetch is a light salmon color, with a pearly luster. The uses and values of these two plants seem to be identical, with the exception that the seed of pearl vetch, it is claimed, is a good table vegetable, being used particularly in making soup. Its seed probably also makes better feed when chopped. What has been said regarding the uses, culture, and handling of the common vetch applies equally well to pearl vetch.

Field Peas.

Field peas (*Pisum arvense*) are well adapted to the conditions of western Oregon and western Washington. They do well on a large variety of soils; but are especially adapted to clay soils and alluvial bottoms. They are grown for grain, hay, ensilage, and soiling. Peas are nutritious, and the hay and ensilage are eaten with relish by most kinds of stock. When grown for hay about 2 bushels of peas and 2 bushels of oats per acre are sown together as early in the spring as the condition of the ground will permit. When sown at the same time the oats often choke out the peas. This may be largely avoided by sowing the peas first, preferably with a drill, since the seed is difficult to cover, and when they have sprouts on them about 2 inches long drill in the oats. This will give the peas the start and they will hold their own much better. If sown broadcast they should be well covered with a disk harrow. Peas should

be cut for hay when the seeds in the first pods are just ready for table use. Sown in the early spring they mature for hay from the 1st to the 15th of July. The yield is from 1½ to 4 tons of hay per acre. When harvested for seed the yield is usually from 25 to 30 bushels per acre. Peas are often sown alone and harvested when mature by swine turned into the field.

The pea weevil often does considerable damage to the pea crop, especially when grown for seed. When sown late, peas suffer much more from the ravages of this pest than they do when sown early. Since they stand considerable frost they should be sown as early in the spring as the season will permit. Of late years peas fail in some localities from other causes than the weevil. They assume a pale, sickly appearance and the yield and quality of the hay are very unsatisfactory. In localities where this happens common vetch and pearl vetch should be grown instead of peas, for they are sure crops and are equal or even superior to peas in practically every way as a forage plant.

Alfalfa.

At the present time the growing of alfalfa (*Medicago sativa*) west of the Cascade Mountains is only in the experimental stage. Small areas are to be found in various places, some of which are doing reasonably well. Most of these have not been planted long enough and have not been studied sufficiently to justify definite conclusions as to the future usefulness of alfalfa in this region. There are many localities with well-drained soils, however, in which it will unquestionably succeed if given proper treatment. In regions in which the rainfall is as great as it is at certain seasons west of the Cascade Mountains, alfalfa requires a loose, permeable subsoil, and seems to thrive best on the sandy loams along the water courses. The best alfalfa fields noticed were on the sandy alluvial soils on the Willamette and Columbia rivers. The water table of land selected for alfalfa should be at least 4 feet below the surface, and the land should not be subject to overflow. Alfalfa will stand considerable flooding, provided the water is running, but it is usually destroyed if stationary water covers it for a few days.

There are two important difficulties to be overcome in the successful production of alfalfa in this region. In the first place bluegrass, English rye-grass, Italian rye-grass, velvet grass, couch grass, and many other grasses and weeds have a strong tendency to crowd out the alfalfa. This difficulty is largely overcome by eradicating these

plants, so far as possible, before the seeding is done. Thorough disking and harrowing at a time when the alfalfa has made but little growth, or just after cutting a crop of hay, tends to keep it vigorous and holds the weeds and grasses in check. The disk harrow should be weighted to make it cut deep and should be set about as straight as possible, so as not to cut off the crowns of the alfalfa plants. Although these grasses, when growing with alfalfa, actually decrease the total amount of forage produced, they also decrease the danger of bloating when the field is pastured by sheep, goats, or cattle. In fact, grasses are frequently sown with alfalfa for this purpose. Secondly, the first and last crops of alfalfa mature at seasons of the year when it is very difficult to make hay on account of the damp weather. This objection is obviated by using the first and third cuttings for ensilage, soiling, or pasture.

Methods of Sowing.

This must be governed largely by local conditions. Land that is naturally well drained or that is tilled at least 3 feet deep should be selected for this crop. If barnyard manure is available, put on from 15 to 20 tons per acre in the fall and plow it under 8 to 10 inches deep. In the spring, when the land is in good working condition, cut it up thoroughly with a disk harrow and work it down fine. Let it lie for a week or ten days; then give a good harrowing so as to destroy all weeds. Sow about 15 pounds of clean seed per acre and cover with a harrow. If the soil is inclined to be dry, finish with a roller. About the time the seed is sown, put on 75 to 100 pounds of land plaster to the acre.*

Inoculation.

The failure of alfalfa west of the Cascade Mountains is frequently due to the lack of nodule-forming bacteria in the soil. If the land to be sown has never grown alfalfa before, it is the safest plan to artificially introduce these organisms. This may be done in two ways:

(1) From 300 to 500 pounds of soil, the more the better, may be hauled from a field that has recently produced alfalfa with nodules on the roots, and scattered evenly over the surface of the new field. This should be done just before the alfalfa seed is sown and the soil should be thoroughly mixed with that of the new field by harrowing or disking. It is quite expensive to inoculate large fields in this way and there is always a possibility of transferring plant diseases from one field to another.

* Dr. James Withycombe, in Bulletin 76, Oregon Experiment Station.

Of scarcely less importance is the danger of disseminating noxious weeds and insect pests through this plan of inoculating by means of natural soils. Even though weeds may not have been serious in the first field, the great number of dormant seeds requiring but a slight change in surroundings to produce germination is always a menace. If soil is to be used, however, whether obtained from near-by fields or shipped long distances, the evidence should be clear that the soil is free from the objections mentioned above.†

(2) Pure cultures of the proper bacteria may be used, The Bureau of Plant Industry of the United States Department of Agriculture has isolated the different organisms for the different legumes, is growing them in pure cultures, and furnishes them to farmers whose soil conditions seem to indicate that inoculation is necessary.

Those desiring inoculating material should write to Soil Bacteriology Investigations, Bureau of Plant Industry, Washington, D. C., for an application blank. To avoid delays, requests should be on file several weeks before the material is to be used.

Should weeds tend to crowd out the alfalfa during the first year, they should be mown often enough to hold them in check. The cutter bar of the mower should be set about 5 inches high in order that the young alfalfa plants may not be cut too closely. If the crop mowed would be sufficient when dry to make a third of a ton or more of hay (and dried weeds) to the acre, which it usually will be in spots, it should be removed from the field; if less than this it may be permitted to lie where it is cut.

The leaves and stems of alfalfa sometimes turn yellow, and the crop then assumes a very unthrifty appearance. When this condition begins to manifest itself the field should be cut immediately, even though the growth be very small. This will tend to invigorate the plants and keep them in a growing condition. If the growth is sufficient the first season, it may be used for either hay or pasture, but under no circumstances should it be closely pastured the first year.

In the moist climate west of the Cascade Mountains it frequently happens that alfalfa sends up young shoots from the crown of the plants before the first growth begins to bloom. When this occurs it should be cut at once; otherwise the first crop soon begins to deteriorate and the second growth will be seriously stunted. In this region it is very essential, therefore, to watch alfalfa closely and cut it as soon as these young shoots begin to appear.

† Farmers' Bulletin No. 240, U. S. Dept. of Agriculture.

Alfalfa is not a satisfactory pasture crop for cattle or sheep because of its tendency to produce bloat in these animals when they are allowed to graze on it, but for horses and hogs, particularly hogs, there is no better pasture.

Timothy.

Timothy (*Phleum pratense*) is the standard grass in Oregon and Washington west of the Cascade Mountains. It is shallow rooted and naturally adapted to moist lands. But the abundant rainfall of this region, distributed as it is through so many months of the year, makes it possible for it to succeed on practically all classes of soils except the sands and gravels. There are individual farmers who like other grasses better, but timothy is the one grass that is universally known and grown. It has been the standard market hay so long and has so many valuable characteristics that it will require years for any other grass, even with superior qualities, to become as popular as timothy in this region.

There are many reasons why timothy enjoys this popularity. It has the best seed habits of any of our cultivated grasses. The seed is usually cheap, has a very high percentage of germination when properly matured, is easily harvested, and retains its vitality remarkably well. The hay is easily cured, stands handling well, and is relished by all kinds of stock. Unlike many other grasses, a few days delay in the time of cutting makes but little difference in the quality of the hay—a very important point in a region where showers are not infrequent during the haying season.

West of the Cascade Mountains timothy is most frequently grown with red clover. It is sometimes sown in the fall with winter wheat and the clover added in the spring, during February and March, when the ground is thawing and freezing. Another method is to prepare the ground in the spring and sow the timothy and clover with or without a nurse crop. Still another way is to sow the clover in the spring with a nurse crop and in September, after the grain has been harvested, sow the timothy on the stubble. When sown with a nurse crop, timothy and clover are shaded too much, especially if the nurse crop is allowed to mature for grain, and unsatisfactory stands are often obtained in this way. Perhaps the most satisfactory way of sowing both timothy and clover is to sow them without a nurse crop in the late summer or early fall on land that is as free as possible from weeds. Good stands are secured in

this way, and they give excellent yields the first year. Timothy is two or three weeks later than red clover, and when they are grown together for hay either the timothy must be cut a little immature or the clover allowed to become too ripe. For this reason some other grasses are better suited than timothy for sowing with red clover. When sown alone from 6 to 10 pounds of timothy seed per acre are sufficient. For a seed crop timothy yields much better when the stand is comparatively thin. A much finer quality of hay is produced when it is thick. It is the general rule to cut timothy for hay just at the end of the blooming period. Cattle prefer the hay when cut at this stage, while horses seem to relish it better if it is a little more mature.

The Rye-Grasses.

English rye-grass (*Lolium perenne*) and Italian rye-grass (*Lolium italicum*) are more popular on the Pacific coast west of the Cascade Mountains than in any other part of the United States. The moist, mild climate of this region is well adapted to their growth, and they are very popular with the comparatively few farmers who grow them. Stock seem to prefer them to all other grasses, and the herbage they produce is certainly of a very fine quality. The rye-grasses form a close sod and stand cropping and tramping well, but they do not yield so well as some other grasses. They mature early and are well suited to sow with red clover. They are especially adapted to low, moist soils, and when grown under favorable circumstances they may be cut two or three times during a season. Italian rye-grass is practically an annual. The plants do not all die at the end of the first year, but they amount to but little after the first season. Although usually considered a perennial, English rye-grass is short-lived and is very little better than Italian rye-grass in this respect. In England, where these grasses occupy a similar position in agriculture to that of timothy in the United States, it is a common practice to allow seed to mature before they are cut for hay. In this way they reseed themselves and last from year to year. It is claimed also that this is a safe thing to do so far as the quality of the hay is concerned.

The seed of these grasses is usually of good quality and germinates well. It weighs from 14 to 20 pounds per bushel. It may be sown in the spring, but early fall seeding gives the best results in this region. When sown alone from 25 to 40 pounds of seed per acre

should give satisfactory stands. The rye-grasses sown with clover make excellent silage.

Orchard Grass.

Orchard grass (*Dactylis glomerata*) thrives remarkably well on all tillable soils west of the Cascade Mountains, except those that are very wet. It is the earliest grass to start to grow in the spring; it revives quickly after it is cropped by stock or cut for hay, especially if the soil is moist; it remains green during the summer and fall, and is relished fairly well by all kinds of stock; it stands grazing and tramping much better than timothy, and lasts for a number of years when given proper care. It is, therefore, eminently adapted for pasture purposes and should form an important part of every permanent pasture mixture.

Orchard grass makes an excellent quality of hay if cut before or just after the blooming period. If the cutting is delayed but a few days beyond this period orchard grass has a strong tendency to become woody, and the hay is then of poor quality. It ripens with red clover, and under favorable circumstances it may be cut twice during a season. It is, therefore, especially well fitted for sowing with red clover when intended for hay. It grows in bunches and does not make a smooth sod; for this reason it is seldom sown alone, Orchard grass is a little early, and is often ready to cut before good haying weather has begun. This fact and its tendency to become woody immediately after blooming are the chief drawbacks to its culture west of the Cascade Mountains. Its earliness is an advantage, however, when it is used for ensilage or soiling.

The seed habits of orchard grass are very satisfactory, and the yield is from 15 to 18 bushels of seed per acre. The seed weighs from 14 to 18 pounds per bushel. When sown alone 20 to 25 pounds of seed per acre will be sufficient. It is sown either in the fall or spring. If sown in the early fall, without a nurse crop, it should make an excellent crop the next year.

Meadow Fescue.

Although meadow fescue (*Festuca pratenses*) is grown but little west of the Cascade Mountains, it is highly prized by those who know it. Like orchard grass, it is adapted to practically all of the tillable soils of the region except those that are gravelly or very wet. It is a perennial; lasts much better than timothy; is relished by all kinds of stock; makes a good quality of hay; and, when once estab-

lished, stands tramping and grazing well. It does not begin to grow so early in the spring as orchard grass, but remains green during the summer and makes a good growth during the fall. It is especially adapted to a place in meadow and pasture mixtures that are to occupy the land for a number of years. One of the leading dairymen of the Willamette Valley sows the following mixture in the spring: Meadow fescue, 10 pounds; English rye-grass, 10 pounds; timothy, 4 pounds; red clover, 4 pounds, and alsike clover, 2 pounds. This mixture is used for hay for two years, and then for pasture three years. Of the grasses in this mixture, meadow fescue is his favorite.

Meadow fescue may be sown in the early fall or spring. When sown alone, from 15 to 20 pounds per acre of the best seed should be used. If the quality of the seed is doubtful, sow more. Kansas farmers who grow their own seed sow only 12 to 15 pounds per acre.

Velvet Grass.

The only part of the United States in which velvet grass occurs to an extent worthy of notice is on the Pacific coast west of the Cascade Mountains, from northern California to the Canadian line. In that section it is indifferently called velvet grass and mesquite. The latter name should never be applied to this grass, as it is used for several other very different grasses in the Southwest.

It is generally regarded as a pest on the Pacific coast, particularly on lands that are very wet in winter and very dry in summer. This is especially the case with both sandy and peaty soils on the coast. It is not utilized for feed in many localities, but on the extensive areas of sandy land around the mouth of the Columbia River and at one or two points inland it is the chief reliance, both for hay and pasture. It yields ordinarily about half a ton of hay per acre. The hay is remarkable for its lightness, a ton of it being much more bulky than a like weight of other kinds of hay. Horses nearly starve before they acquire a taste for velvet grass, but when the taste is once acquired they thrive upon it remarkably well, showing that it is highly nutritious. The whole plant is covered by a growth of wool-like hairs, from which fact the name is derived. It is unworthy of attention except on the classes of soils above mentioned. On these soils it drives out all other grasses.*

Velvet grass (*Holcus lanatus*) is frequently a pest in meadows. The seed matures very early, is light, and shatters readily. When clover, rye-grass, and timothy are ready to cut for hay the seed of velvet grass is usually mature enough to germinate. The wind blows the seed, and wherever the hay is hauled or handled the seed is scattered. If a meadow that is infested with velvet grass is cut a little early for either hay or ensilage, the seed cannot be spread in

* W. J. Spillman, in "Farm Grasses of the United States."

this way. Velvet grass gives no trouble in the second crop of clover. Fence rows and waste places beside meadows should be mown early enough to prevent seed from maturing. If these precautions are taken the grass can be prevented from becoming very troublesome.

To eradicate velvet grass cut it early, before the seed is ripe, generally from the 10th to the 20th of June. About the 1st of July give it a thorough but shallow disking. Repeat the shallow disking every week until the 1st of August and then spring-tooth and disk again. This shallow cultivation during the driest season will kill the roots and leave the ground with a very fine mulch on top and plenty of moisture in the subsoil. The land may then be reseeded to clover or planted to any crop desired.*

Indian Corn.

The climatic conditions of western Oregon and western Washington are not well adapted to the growing of corn (*Zea mays*). The nights are too cool for its best development, and unless very early varieties are grown difficulty is often experienced in bringing it to maturity. Nevertheless, corn fills an important place in the cropping systems of this region, particularly on dairy farms; *i. e.*, for ensilage and for feeding green during August, September, and October. While it may be impracticable to grow corn for the grain, it is possible, by selecting very early varieties, and using seed grown near by, to grow a good quality of ensilage corn. The aim should be to grow those varieties that reach as near maturity and yield as much grain as possible. The large southern varieties produce very little grain here and are so immature when put into the silo at the end of the season that too much acid develops.

Water and Dry Matter in Corn at Different Periods after Tasseling.

New York (Geneva) Station.

Date of cutting.	Stage of growth.	Corn per acre.	Water per acre.	Dry matter per acre.
		Tons	Tons	Tons
July 30	Fully tasseled.....	9.0	8.2	.8
Aug. 9	Fully silked	12.9	11.3	1.6
Aug. 21	Kernels watery to full milk.....	16.3	14.0	2.3
Sept. 7	Kernels glazing.....	16.1	12.6	3.6
Sept. 28	Ripe.....	14.2	10.2	4.0

This table is very interesting. The last column shows the dry matter of corn at different stages of growth. Ripe corn yields five times as much dry matter per acre as corn that is fully tasseled; two and two-thirds times as much as corn fully silked; and nearly one and three-fourths times as much as corn in the milk. Hence,

* Letter from W. H. Kaufman, Bellingham, Wash.

the importance of growing corn for ensilage that will mature. The table also shows the great waste in feeding corn green instead of letting it mature properly and making it into ensilage.

In order that ensilage may keep well, corn should be cut about the time the kernels are well glazed and dented. If it is cut too green, as stated above, too much acid develops; if cut too ripe it does not settle properly and the air is not sufficiently excluded to prevent spoiling. The ripest corn should always be cut first and placed in the bottom of the silo because the great pressure near the bottom will tend to exclude the air.

If planted on rich, mellow, well drained land, between the middle of May and the first of June, corn should be ready for feeding green from about the first to the fifteenth of August. As stated above early varieties should be planted and seed grown west of the Cascade Mountains succeeds better than eastern seed.

Rape.

Rape (*Brassica napus*) has been grown in the Willamette Valley with excellent results for twenty years. It is a succulent, nutritious forage plant, admirably adapted to the moist, mild climate of the Pacific Coast. It stands considerable freezing and is seldom winter killed west of the Cascade Mountains. It does best on deep, warm, well-manured, loamy soils. It succeeds well also on peaty soils, but is not adapted to very light sandy or heavy clay soils. It is a heavy feeder and must not be expected to succeed on poor, worn-out land.

It is an excellent crop for pasture or soiling; *i. e.*, for cutting and feeding green for hogs, sheep, goats, and poultry. Fed to dairy cows, it causes a large flow of milk; but to avoid tainting the milk it should be fed immediately after milking, at the rate of 20 to 50 pounds per day, in two feeds. On account of danger of bloating, sheep, goats and cattle should never be turned on rape for the first time when they are hungry, or when the rape is wet with dew or rain. They should have plenty of something else to eat first, and plenty of salt at all times. It is a good plan to give them access to hay or grass pasture to prevent overloading on rape. When sheep have become accustomed to it, they may be left on it continually with but little danger.

Rape is grown and utilized west of the Cascade Mountains in several different ways:

(1) When grown for early summer use, the largest yields and the best results are secured by making a succession of plantings at intervals of two or three weeks, beginning in the early spring as soon as the ground can be put into perfect tilth. The ground should be well manured, and the seed planted in drills 24 to 36 inches apart, at the rate of about 2 pounds per acre. A common garden drill may be used in planting small areas, but for larger fields a grain drill, with some of the feed hoppers closed to make the rows the desired distance apart, will probably answer the purpose best. As soon as the plants are large enough they should be cultivated often enough to control the weeds and keep the soil in good tilth. The cultivation will retain the soil moisture and tend to keep the plants growing vigorously. Unless cultivated during the dry portion of summer, growth almost ceases until the fall rains come. Rape grown in this way may be used either for pasture or for soiling.

When rape is used for soiling purposes it should be cut at least five inches high so that the plants will have a chance to grow again. In from six to eight weeks after planting it should be large enough to cut; by making a succession of plantings, green, succulent feed should be on hand throughout the summer. If rape is used for pasture the best results will be secured by having a number of small fields which are pastured alternately. It may be fed in this way, also, by means of movable fences. Rape should be from 12 to 14 inches high before it is used for pasture and hogs should be prevented from rooting while in the field. When rape is removed by cutting or pasturing closely, the evaporation of soil moisture is rapid, and it should be cultivated as soon as possible if a second growth is desired. If sown in drills, stock will walk between the rows while feeding and much less will be broken down and destroyed than if they were feeding upon rape that was sown broadcast. A larger yield is also secured by planting rape in rows and cultivating it.

(2) Another favorite way of growing rape is to sow it broadcast at intervals in the spring. The land should be plowed and thoroughly worked in the early spring, as soon as it is in good working condition, and then allowed to lie until the seeding is done. Just before each piece is sown the ground should be cultivated thoroughly again and from 3 to 4 pounds of seed sown and covered with a harrow or cultivator. Instead of sowing the seed broadcast it may be planted with a common grain drill. Rape sown the first of May

should be ready for pasture the first of July; if sown the first of June it should be ready for pasture by the first of August. Grown in this way, rape makes excellent pasture during the summer, fall, and early winter.

(3) Another method of raising rape that is popular with many farmers, especially those who raise sheep or goats, is to grow it with clover. The method of doing this has already been fully stated in the discussion of red clover (page 14).

(4) Rape is sometimes sown with oats in the spring on a thoroughly prepared seed bed. The oats may be used for either hay or grain. The rape grows but little until the early fall rains come, after which it is soon ready for pasture. From 2 to 4 pounds of rape seed per acre should be sufficient when sown this way.

(5) From 3 to 4 pounds of rape seed per acre are also sown with corn just before the last cultivation. The seed is then covered by the cultivator and the rape comes on and makes good pasture as soon as the corn is harvested. It may also be sown with potatoes, but it does not succeed so well with them as with corn, for the digging of the potatoes destroys much of the rape. Sown after early potatoes are dug, it gives good pasture during the late fall and early winter.

The Seed Crop.

Good rape seed is now produced in the Willamette Valley and the region about Puget Sound, and there is no reason why farmers should not produce their own seed. Rape is a biennial and does not produce seed when sown in the spring until the second year. If sown in September or October it matures seed the following June. Rape may be cross-fertilized by kale, cauliflower, and other closely related plants. It is believed to cross also with wild mustard and wild turnips; hence none of these plants should be allowed to grow near rape that is intended for seed.

For seed, rape should be sown alone, and it is very desirable to have it in drills in order to cultivate it and keep it free from the plants mentioned. Rape that is planted in drills in the spring may be used for soiling during the summer and fall, carried through the winter, and used for a seed crop the second season. If sown entirely for a seed crop, it may be planted in the fall--September or October--after some early crop has been removed. To retard development of the plants so that the seed will mature after the late spring rains are over, it should be pastured or cut back about the last of April

or the first of May. If ripe rape gets wet the seed shatters very readily, and the retardation of the development of the crop is often very necessary in order to have good weather for harvesting the seed.

Rape should be cut for seed when the first seeds are turning brown. It may be cut with a binder or a self-raking reaper. It should be shocked in such manner that it will dry out quickly. Birds destroy considerable of the seed; hence it should be thrashed as soon as dry. If the crop is not too extensive a man with a team and sled may drive from shock to shock and thrash it by hand. If a thrashing machine is used, it should be hauled to the machine in tight-bottomed racks, or canvas should be spread over the racks to catch the shattered seed. It is said that a yield of 1,000 pounds of seed to the acre is not unusual in the Willamette Valley.

Seed may be purchased of local seedsmen. When buying seed, however, one should always call for Dwarf Essex rape. There are a number of varieties of rape, some of which are annuals and are grown only for bird seed. If these annuals are sown in the spring they produce seed the same year and are liable to become serious pests when once introduced. Complaint has been made that Dwarf Essex rape becomes a weed, but it is easily controlled. It does not produce seed until the second season, and if plowed under during the fall, winter, or spring no seed can be produced.

Thousand-Headed Kale.

Thousand-headed kale (*Brassica oleracea*) has been grown in the Willamette Valley for 27 years. It attracted little attention among the dairymen until recent years, but is now rapidly becoming a very popular fall and winter soiling crop. It stands the mild winters west of the Cascade Mountains admirably and is hauled from the field and fed as needed. It does not head up like cabbage, and the name "thousand-headed" is given it on account of the numerous branches the plants have when given plenty of room. It is very much like rape, but the plants are much taller and the leaves are longer and broader. A field of this crop is shown in figure 2. It is claimed that kale will yield 30 to 40 tons of green feed per acre when grown under favorable conditions.

Kale is used for table greens, but its chief use on the Pacific coast is for feeding green to dairy cows from October to April, for which it is highly prized. It would undoubtedly be an excellent winter feed also for hogs and poultry. It does best on well manured, deep

rich loams and sandy soils. The only objection to the use of kale is the difficulty of getting it out of the field when the ground is wet and muddy. For this reason well-drained land should be selected upon which to plant this crop.

Methods of Sowing.

For fall and winter use, kale is usually sown in drills on well-prepared and well-drained soil as soon after the 15th of March as the season will permit. This furnishes plants for transplanting in



FIG. 72—A field of thousand-headed kale on Martins Island, near Kalama, Wash. A valuable winter soiling crop, available from October 1 to April 1.

June and July. The land used for transplanting is well manured and plowed two or three times between the 1st of March and the 1st of June. With the land in perfect tilth it is plowed again with a 12-inch plow about the first of June and the young kale plants dropped into every third furrow about $2\frac{1}{2}$ to 3 feet apart. This places about one plant on every square yard. The roots of the plants are placed where the next furrow covers them, leaving the tops uncovered. The plants that are plowed in during the day in this way are rolled in the evening of the same day to pack the

ground. Two or three cultivations are all that can usually be given, for the plants will soon touch in the row if they do well. Any plants that fail to grow may be replaced by hand. Some growers prefer to plant the seed in hills, and when the plants are large enough thin them to one plant in a hill. Others put kale out just as cabbage is usually transplanted, instead of plowing it in. The time of transplanting must be determined by the size of the plants and the condition of the land. If the land is wet and subject to overflow the transplanting may be delayed until during July. If the land is well drained and the plants are large enough it may be done before the 1st of June. In transplanting, enough plants may be left for a stand on the land where the seedlings are grown.

Feeding.

As previously stated, kale stands in the field during the winter and is hauled in and fed green as needed from about the 1st of October to the 1st of April. If the growth is forced in the early spring it can be fed much earlier than the 1st of October. To avoid tainting the milk, kale is fed just after milking, at the rate of 25 to 50 pounds per day, in two feeds. Some let it wilt before feeding. Enough may be hauled in at a time to last four or five days. It should not be thrown into heaps and allowed to heat. Neither should it be fed when frozen. On the approach of freezing weather a supply sufficient to last several days may be placed in the barn.

To haul kale from the field during wet weather it is best to wear a gum coat and gum boots. The plants can then be cut off at the surface of the ground with an ax, thrown into piles, and loaded on a wagon with a pitchfork without serious inconvenience to the worker.

Kale grows a great deal during the fall and winter, and much is lost by feeding the whole plant in the early part of the feeding season. By using only the lower leaves it is possible to begin feeding quite early without stopping the growth of the plants. With the thumb and fingers of the hand extended, one can break off all of the lower leaves of a large plant with three or four downward strokes of the hand. This is not practicable, however, during damp weather, for the leaves would be too wet to handle in this manner.

The Seed Crop.

An excellent quality of kale seed is produced in the Willamette Valley. Like rape, it is a biennial and does not produce seed until the second year. Richard Scott, a dairyman of the Willamette Valley, has grown kale for twenty-seven years. He produces seed about as follows: There is considerable variation in the types of individual plants. During the first year plants with many rather narrow leaves that begin spreading from near the surface of the ground are selected. This type of plant yields more and stands freezing better than a plant the stem of which is bare for some distance above the ground. These selected plants are transplanted in February in some isolated place to prevent cross-fertilization by undesirable kale plants, rape, cauliflower, and other closely related plants. It is believed that kale crosses with wild mustard and wild turnip; hence none of these plants should be allowed to grow near kale that is intended for seed. The seed crop is cut when the first seeds are turning brown. If the crop is small, it is usually thrashed by hand. A large crop may be handled the same as a seed crop of rape. Birds are fond of the seed, and for this reason it should remain in the field only until dry.

Root Crops.

Since the soil requirements and the methods of culture of mangelwurzels (*Beta vulgaris* var. *macrorhiza*), Carrots (*Daucus carota*), and ruta-bagas (*Brassica campestris*) are very similar, they will be treated collectively. Like rape and thousand-headed kale, they succeed best where the weather is moist and cool. Hence their eminent adaptation to western Oregon and Washington. In this region the yield of these crops is enormous, the ordinary yield being from 20 to 35 tons per acre, while reports of 45 or 50 tons are not infrequent.

Root crops usually succeed best on deep, moist, friable loam soils. On clay land they grow too closely, and the soil is also difficult to work. Ordinarily, land for roots is heavily manured in the fall and then plowed considerably deeper than for other crops. If the soil runs together badly during the winter, it is replowed in the early spring. Instead of the above procedure, the manure is sometimes spread during the winter, the land plowed deep in the early spring, and a fine, firm seed bed formed immediately by disking, harrowing, rolling, planking, etc., as the conditions may require.

Between the preparation of the seed bed in the early spring and planting the seed during April or early in May the land is cultivated sufficiently to keep the weeds subdued. Just before planting the seed a thorough cultivation is given, finishing with a planker or clod masher. This destroys the weeds, thoroughly pulverizes the soil, and leaves the surface smooth and in good condition for planting.

Mangel-wurzels and ruta-bagas are usually grown in rows from 22 to 30 inches apart. When planted in continuous rows, enough



FIG. 3.—A "scuffle" hoe devised and used by W. J. Langdon, Sumner, Wash., in thinning and weeding root crops. A very effective implement.

seed is used to insure a good stand. When sown with a hill-dropping planter, the hills are from 8 to 15 inches apart and 4 or 5 seeds are dropped in each hill. The rows of carrots are usually 18 inches apart and the hills 8 inches.

As soon as the plants can be seen in the rows, the wheel hoe is started. With the guards of the hoe next to the row, the cultivation is done as close to the row as possible without covering or disturbing the plants too much. Considerable hand weeding and hoeing between the hills and along

the rows are usually necessary. When the plants are 3 or 4 inches high, they are thinned, leaving the most vigorous plant in each hill. When sown in continuous rows, the thinning is largely done with a hoe, striking across the row. Subsequent cultivation should at least be sufficient to keep the weeds under control. As much of it as possible is usually done with a horse cultivator.

Instead of the common and wheel hoes for thinning and weeding, some prefer to use a "scuffle" hoe. (See figs. 3 and 4.) When in use, the blade of such hoes is in a horizontal position and is pushed and pulled just under the surface of the ground. The blade shown in figure 3 is diamond shaped, about 2 inches wide in the middle and one-half inch wide at each end, and about 8 inches long. About an inch of the tip of one end is turned up at a right angle to form

a guard for working close to small plants. The blade of the hoe should be sharp on both edges, so that it will cut each way when pushed and pulled. In order to make it take hold properly, it may be necessary to bend the edges of the blade down slightly. To give the handle the proper angle, the shank should be curved. It should flatten out into a narrow, thin plate about 2 inches long and fasten to the blade by means of two rivets. This hoe is not on the market, but may be made by any blacksmith. An old saw makes excellent blades. The shank should be made of Norway iron, so that it may be bent to give the handle the proper angle.

Ruta-bagas are sometimes sown in drills in the early spring and transplanted like cabbage. The plants may be transplanted like kale, as the land is plowed. The roots of the plants are placed where the next furrow will cover them and the tops are left sticking out. For this method of transplanting, see the discussion of kale.

About the 1st of November the roots are topped, pulled, and placed in narrow bins in the barn. Upon the approach of cold weather they are covered with hay or straw. The tops are sometimes cut off with a sharp hoe and the roots then dug with a potato fork. More generally they are dug first, the worker pulling on the top of the root with one hand as he bears down upon the handle of the potato fork with the other. The roots of two or three rows are laid together with the tops one way. The tops are then cut off with a long-handled knife. Some twist the tops off, claiming that the roots do not bleed and wither so much as they do when the tops are cut off. Roots are grown mostly for winter use and are fed up to



FIG. 4.—A "scuffle" hoe similar in principle to that shown in figure 3, devised by A. B. Leckeny, Seattle, Wash. The blade of either of these hoes may be made from an old saw blade.

the 1st of April. They are generally sliced before being fed to dairy cattle. Some dairymen feed them whole, claiming that cows can handle large roots nicely and that, unless the slicing is carefully done, they do not choke so frequently when feeding on whole roots as they do on sliced roots.

The flat or fall turnip (*Brassica rapa*) is also grown in western Oregon and Washington. Since it matures quickly, grows mostly above ground, and has a flesh less firm than that of other roots it does not keep well and is adapted only to fall and early winter use. Its soft flesh and habit of growth above ground make it an admirable root to be harvested by stock turned into the field. It is usually sown broadcast on clean land about the 1st of July. It may be sown also in corn. If intended for winter use it should be gathered and put into bins before becoming water-soaked from fall rains.

Soiling (Green Feeding) Crops.

The mild winter climate and abundant rainfall of western Oregon and Washington make it almost an ideal region for the production of soiling crops. By the judicious selection and planting of crops, green succulent food may be provided for the dairy cow during practically the entire year. That a much greater amount of feed can be obtained from the same area of land by this system as compared with pasturing is a fact well recognized by progressive dairymen. Much of the tillable land of this region is now very valuable. As values advance beyond the limit where farm land may profitably be used for pasture, and it becomes necessary for the small farmer to keep the maximum amount of stock upon his few acres of tillable land, the growing of soiling crops becomes of vital importance.

Below is given a list of the crops that are used for this purpose. The dates of planting and the approximate dates upon which these crops may be used are also given. It must be definitely understood, however, that the variation in the seasons prevents one from saying definitely when a crop will be ready to use. For further information regarding these crops the reader is referred to the discussion of each in former pages of this bulletin.

Soiling Crops for Western Oregon and Western Washington.

Crops.	When planted.	When used.
Rye and vetch	September 1-15	April 1 to May 1.
Winter oats and vetch	September and October	May 15 to July 1.
Winter wheat and vetch	September and October	May 15 to July 1.
Red clover .....	.....	May 15 to July 1.
Alfalfa .....	.....	During June.
Oats and peas	February	During June.
Oats and vetch	February	June 15-July 15.
Oats and peas	April	During July.
Rape	May 1	During July.
Oats and peas	May	During August.
Rape	June	During August.
Corn	May 10-20	During Aug., Sept. and Oct.
Turnips	July 1	Late fall and early winter.
Thousand-headed kale	March 15 and transplanted .....	.....
.....	June 1 .....	.....
Mangels, carrots and rutabagas	April	October 15-April 1.
.....	.....	October 15-April 1.
.....	.....	(Fed from bins, pits, or root house.)

SEEDING TIMBER BURNS AND BURNT SLASHINGS.

As previously stated, dense forests of evergreen timber cover a very large portion of western Oregon and western Washington. During the dry season of the year forest fires overrun large areas, killing practically all vegetation and leaving a loose blanket of ashes on the surface of the ground. These burnt areas, if left unmolested for a few years, usually produce a dense growth of young trees and brush and are practically worthless for grazing purposes. In clearing land it also frequently happens that the timber and brush are slashed and burnt several years before the stumps are removed. By properly seeding these burnt areas they may be made to produce excellent pasture. Since the stumps are in the ground and there is, therefore, no chance to cover the seed, the seeding should always be done in the fall before the ashes have settled. The first rain that comes will then cover the seed sufficiently to insure good germination.

Since there is little chance to improve or renew the stand on account of the stumps and timber remaining on the land, only seed of those plants should be sown that last a long time, stand close cropping, and yet produce as much growth as possible. If the seed is sown in the unsettled ashes as indicated above, little difficulty will be experienced in getting good stands of white clover, alsike clover, red clover, orchard-grass, meadow fescue, timothy, and English rye-grass. A mixture of 1 pound of white clover, 3 pounds of alsike clover, 10 of orchard-grass, and 10 pounds of meadow fes-

cue per acre should give satisfactory results when sown in the unsettled ashes in the early fall. Timothy will also do well for this purpose. Red clover and English rye-grass are each short-lived and should form but a small portion of the mixture if sown at all. Timber burns that have been seeded down in this way should be pastured pretty closely to keep down the young trees and brush. Goats will help to do this better than any other kind of animals. The success of seeding burnt areas in this way has been thoroughly demonstrated in many parts of the region. It is only a question of sowing the proper seed at the proper time.

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Oregon Agricultural Experiment Station.

CORVALLIS, OREGON.

THE WALNUT IN OREGON

BY C. I. LEWIS.

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INTRODUCTION.

The following pages from the pen of one who has been within the state a comparatively short time cannot pretend to constitute a complete treatise on the subject of walnuts and walnut culture in Oregon. It is hoped that they will nevertheless be found adequate to our present urgent need.

Walnut growing is rapidly becoming an important industry of our state and there is a dearth of reference material upon the subject for the information and guidance of growers. We are at the present time at the Station receiving many letters requesting information concerning walnut culture. For these reasons I have been making a close study of the subject, gathering data from as many sources as possible. I have visited as many orchards and trees as were accessible; have freely consulted all available references in the form of reports, reference books, and articles written on the walnut; and especially have drawn suggestions from agricultural publications, from speeches, and from personal interviews with such men as Mr. H. M. Williamson, editor of the Oregon Agriculturist, Mr. M. McDonald of the Oregon Nursery Company, Mr. J. B. Pilkington of Portland, Mr. Ferd Groner of Hillsboro, Col. Henry Dosch of Portland, Mr. Thomas Prince of Dundee, and many others. From these sources of information I have sought to cull such points as seem essential to our present need, and from these to draw such conclusions as are conservative. As such I present the following notes, realizing that they are not only far from complete, but that they will not agree in every detail with many of the ideas of our best authorities. However, the walnut industry is in its infancy, and, as with all new enterprises, there are many theories and suppositions concerning it that perhaps in later years will not hold true. So it is hoped that at least this bulletin may be of value in satisfying the demand for information upon the subject of which it treats; in helping many to overcome some of their difficulties; and in guarding uninformed persons against certain practices that will, if adhered to, hurt the industry.

HISTORY.

The English walnut (*Juglans regia*) has been grown for centuries in western Asia, especially Persia, whence it has been introduced by invaders and traders to various parts of Europe, namely, Italy, Spain, France, Germany, and England; and it is moreover variously named, after all these countries. From Europe it was introduced into America and for over a hundred years walnuts have grown in different parts of New York State, and farther south; but the large planting has been in California. There the industry was introduced by the Spanish friars, who brought with them the Spanish strain, which is a soft-shelled type, such as the Soft Shell and the Santa Barbara. Walnuts have been introduced into South America also. In later years French strains of such varieties as the Franquette and Mayette have made their appearance, and the introduction of these bids fair to revolutionize the walnut industry in America. Not only will they be grown here in Oregon, but the chances are that the French nuts will in the near future be the chief nuts grown in California itself. They are the hardier nuts and come from climates much like our own.

Present Condition of Walnut Culture in Oregon.

Scattered all up and down western Oregon we find the English walnut growing, in plantings ranging from isolated trees up to those of one hundred acres. The majority of these trees are in bearing and go to prove that we have conditions here suitable for growing the walnut. While many of the trees over the state never bear, or produce only inferior nuts, there seems to be ready explanation for their failure. The barren trees are either the California type, principally Santa Barbara, or they are trees grown from nuts picked up at stores. The climate here is such that almost invariably the frost catches these trees, at times even injuring the tree itself. In sheltered places the Santa Barbara occasionally bears. The trees bearing inferior nuts are chiefly seedlings which were not chosen with care. - We also find in places quite old trees that have made little or no growth, and investigation shows soil conditions to be such that only failure might be expected. Thus we see that we must choose our trees with care and have soil of the right condition. With this care, orchards up to fourteen years of age are doing nicely. However, we have no old orchards. Our old trees are principally isolated trees and perhaps they are not a fair index of what

a whole orchard at their age would do. As regards young trees we find, for instance, that Mr. Thomas Prince has three hundred fifty trees planted in 1897, and two thousand trees planted in 1898. Last year he harvested between two and three tons of nuts and this year between four and five tons. Dr. Finck of Dallas has a tree now thirteen years old which two years ago bore seventy pounds of nuts. Mr. C. H. Samson of Grants Pass has two hundred fifty trees nine years old that began bearing at seven years. Mr. Tiffany of Salem has a tree fourteen years old which last season produced one hundred fifteen pounds of nuts. Mr. E. Britt of Jacksonville has a tree that has never failed a crop for twenty years. In addition to these there is quite a large acreage of young trees. In the neighborhood of Mr. Prince's orchard at Dundee we find about three hundred acres. Mr. Ferd Groner of Hillsboro has eighty acres. At Jefferson, Shedd, Jacksonville, Ashland, Merlin, and Grants Pass, are quite large plantations. From the crops taken from isolated trees at twenty years and over we might assume that the orchards at that age will be heavy bearers. However, we have not as yet the proof. While I myself have such faith in the future of the walnut in Oregon that I would feel willing to set out a walnut orchard, I would not want to give such advice as to lead anyone to stake his all in walnuts. Let us be conservative and plant in moderate quantities, and the near future will demonstrate without a doubt what the walnut will do. The future seems very rosy but until our young orchards have reached an age of about twenty years and have shown that they are heavy bearers, we have not the right to proclaim that the walnut in Oregon is a decided success.

PROPAGATION.

At present among walnut growers there is more or less controversy as to whether we shall plant nuts, seedlings, or grafted trees. Some maintain that only by planting seed in the place where the tree is desired can good results be realized; but broad investigations over the state do not bear this out. True it is that in situations that are not very favorable to the walnut a seed will establish itself sooner than the transplanted tree; but such conditions should not be accepted for the walnut. Ordinarily, where the seed has been planted, it does seem to make a better growth for four or five years, but after that no appreciable difference is noted. If seed is planted, great care must be used in its choice. We hear a great deal about

generation and the term has to the average person more or less of a mystical association. It may mean something and it may not. We have been told that the walnut is different from other trees in regard to the laws of heredity; but a careful examination does not prove this to be so. Now, original trees and their grafts are known as first generation trees, and nuts from these trees are called first generation nuts. These produce second generation trees, and their nuts are called second generation nuts. These nuts would produce third generation trees, and so on. We are told to plant only first generation nuts and it is held that the trees from these will bear larger and better nuts than first generation trees bear, but that after this the nuts rapidly grow smaller. The author holds that first generation nuts may be good and that they may not. In order for these to be valuable they must be procured under the following conditions: They must come from a grafted tree, or from a grafted orchard of one variety, which is isolated. Otherwise we can have practically no assurance that we can have trees that will bear good nuts. Even if the orchard is isolated, we cannot be sure that all the trees will produce good nuts. While in many cases the nuts produced are larger than those from the original grafted trees, on the other hand they are sometimes smaller and inferior. Accidental cross pollination and better or poorer growing conditions will play their part. As regards all this theory about walnuts and generation, it simplifies itself down to about this—the walnut is bisexual and self-fertile. An orchard, therefore, that is isolated, and of only one variety, will have little chance, of course, to become pollinated from other varieties. The result will be that a large percentage of its nuts will be fairly true to type; but we must expect more or less variance. A visit to the orchard of Mr. Prince will confirm this. We find there hardly any two trees of the same variety that are exactly alike either in tree characteristics or in nut characteristics, altho the parentage can be easily traced. Nuts from such an orchard as Mr. Prince has, containing a great number of varieties, would make poor seed, for the reason that they would cross, and the following generation would be a grand mixture, from which would doubtless come a great many inferior trees, as well as some trees with about the same characteristics as his varieties possess (such as Franquette, Mayette, Parisienne, etc.), and a few better in certain characters, probably, than the parents. Indeed, this has actually come to pass. Mr. Prince himself has a seedling of

exceedingly promising characters, while another such seedling has occurred at Salem, from the Franquette. As we proceed with other generations the tendency to vary would be greater and greater. The walnut, then, follows the general rule of plant life. This does not mean that good results cannot be obtained from seedlings from grafted trees, provided the said grafted trees were isolated, because the chances are that the planter would have enough good trees—say, five or seven to the acre,—from whatever he plants to meet all requirements, thus making allowance that some of the trees will bear inferior nuts and that some of them will bloom so late as not to have time to mature. But one can afford to sacrifice these. Again, these seedling trees are much easier to procure at the present time than the grafted trees. But if seedlings are being handled they should be taken from such an orchard as above mentioned, or else imported French seedlings of good character should be purchased. Otherwise, plant imported French nuts or nuts from an isolated grafted tree or orchard. Under no conditions plant nuts picked up from a store. Caution should be exercised in purchasing nuts from local trees that are called by the names of certain varieties. Plate 18 shows a nut that I found in Salem being sold as Mayette, which had practically no Mayette characteristics.

Another class of trees that could be planted is the grafted trees. These are hard to procure and are expensive, but undoubtedly if we are to put the walnut industry where it belongs, we must learn to graft with more success. Each walnut tree has its individual characteristics and we should choose with great care the scions from those trees which have the commercial characteristics as regards nut, and which are vigorous and prolific. An orchard of such trees would have many times the value of the average seedling orchard. The nuts would be of the same type and size and would be able to demand better prices.

GRAFTING.

Trees are grafted on their own stock (*Juglans regia*), or the California Black (*J. Californica*), and on the American Black (*J. nigra*). We also have several methods of budding and grafting, but none of the methods has so far brought a large percentage of good grafts. Occasionally we hear of men who claim that they can graft over 90%, but further investigation generally shows that such is not the case. Of the American grafters, Mr.

Geo. Payne of California is about the most successful of whom I have heard.

When trees are grafted on their own stock they make rather slow growth and for this reason the method has not met with much favor. When grown on California Black walnut stock they make a rapid growth and seem to come into bearing sooner, and will, it is claimed, grow in heavier soil. On American Black walnut they make rather slow growth. Mr. Prince, of Dundee thinks that a good deal of the failure in grafting has been due to the fact that too soft wood has been used, and that where two-year-old wood has been used better success will be met with, as the one-year-old wood is soft and tends to be pithy. Doubtless he is right. On the other hand, Mr. Payne of California, I believe, uses the yearling wood, grafting either the two-year-old or the four-year-old tree. The three-year-old tree is too large at the collar to be easily grafted and too small to be top-worked easily. The two-year-old tree can be easily root-grafted or collar-grafted, and the four-year-old can be easily top-worked.

As regards the kind of wood to use, it will probably depend largely upon the system of budding or grafting employed, as we should as nearly as possible have stock and scion or bud of nearly the same condition. The French are having considerable success grafting in the southern part of France, and in northern Italy, while in northern France little success is being met with except in the greenhouses. Mr. Gillet, of Nevada City, California, states that the common mode of shield budding as employed on fruit trees fails with small walnuts, say three years from the seed, and rarely succeeds on the larger stocks. When used on the latter he advises removing the wood from the inner side of the strip of the bark on which the bud is set, making this strip at least two inches long, and as broad as possible; but even under these conditions he has had very little success. Flute budding has been used as much as any form. This was recommended for nuts by Mr. J. L. Budd, of the Iowa station, and the method is shown in Plate 3. Grafting by this method is generally done in summer, about June, when the bark slips easily. Choose scions from one-fourth to three fourths of an inch in diameter, removing a ring of bark one and one-half to two inches long. This should have a good strong bud. Cut off a limb of the stock, leaving a stub from which a smaller ring of bark is removed. Carefully split the ring from the scion and apply

it to the stock, taking care that it neatly fits the remaining bark or stub and that the split edges unite. The parts should be nicely united and not bruised. Cover the whole with a paper sack, being careful to see that it is tied below the wound. This method has been more or less successful in top-working. For use in small trees in the nursery or for top working small branches on large trees, a modification of this form, known as ring or annual budding, is often used. In this case the top of the stock is not removed until after the bud has grown fast. Crown grafting is the most successful method used with young trees and can be successfully done with either whip, cleft, or sap. Any seedling not greater than four inches is chosen. Before grafting, remove the earth for several inches around the base of the tree, and then smoothly cut off the base several inches below the ground line. The graft is then bound with wax, cloth, or the tying materials, and then earth banked up to the top of the scion. Sometimes cleft grafting is used, such as is shown in Plate 4; but this rarely meets with success when carried out by the method illustrated. When cuts are made through the sap wood instead of through the heart wood, more or less success can be expected. Another method of top-grafting is the prong grafting or budding. This is much like shield budding, with the exception that a prong instead of a bud is used. There are, of course, many other methods of budding and grafting that might be used but they have no particular advantage.

Where seed is planted, several methods can be used. Good success was obtained by Mr. Prince by planting nuts at various times from the first of February to the middle of April, in good rich, but loose soil, planting the seeds on their side at a depth of two and one-half inches. It might possibly be better to plant them a little deeper than this (See plates 1 and 2). It is also noted that the later plantings—about April—seem to give better results. Others recommend that the seeds be planted in boxes and sprouted first and then planted in nursery rows four feet apart and one foot apart in the row.

SITE.

It is sometimes stated that the walnut will grow on almost any soil. This statement is not true. There is no tree that demands as much care as the walnut in the selection of the soil, especially when grown on English walnut roots. It is claimed, and reasonably, that, when grafted on either American Black or California

Black, the tree will stand heavier soil. The walnut is a heavy feeder and the soils that suit it best are the good, deep, rich, moist loams, at least fifteen feet deep and well drained, altho these are not necessarily the only soils upon which it will grow. Mr. Prince of Dundee is getting splendid results on his red hill land, which is the typical red soil, but is deep. This perhaps will not produce as rapidly growing trees as similar land a trifle heavier, such as we find, for instance, in and around Salem (See plate 6). The soils to be avoided are those which are underlaid near the surface by hardpan, and those underlaid near the surface with rock, cement gravel, or loose gravel. In the former the tap root will grow for a short time but cannot penetrate the hardpan, and the tree will cease growing. The latter soils should never be selected—they are too light and thin. Much of our valley land is too heavy and poorly drained. Probably the best site as regards soil will be found in the rolling land such as found in large quantities in the Willamette Valley counties. On the rolling lands we will get better drainage of soil and also the chances are better for good circulation of air around the trees to keep them in good health and at times avoid frost. The preparation of the ground should be about the same as for a fruit orchard—good deep plowing and thorough harrowing will bring their rewards. We find fine illustrations of this in visiting Mr. Prince's orchard, where every precaution was taken in preparing the ground and handling young trees, while in that vicinity are several neighbors who did not take these precautions. Today Mr. Prince has handsome trees, while some of the neighbors mowed down their trees with a mowing machine.

PLANTING THE TREE.

It was formerly thought that it was disastrous to the walnut to break or cut the tap root, but it has been found that it causes no injury to cut off the tap root in planting, as this action generally induces new tap roots to appear and also produces a better, healthier root growth. In all cases remove the tap root with a sharp instrument, making a clean cut. The tree should then be carefully set, taking care, as with a fruit orchard, to have the trees thoroughly lined and firmly set. As regards distance to plant, great errors have been made, and we shall probably have to go through with the walnut exactly what we have done with the apple. Many walnut growers were led to believe that it was to their advantage to plant

trees from twenty to thirty feet apart, and later to remove some of these trees, realizing a fortune from the lumber. These persons will generally be doomed to disappointment because such walnut wood is not of good quality. Where the trees grow in the forest they make straight smooth trees. Out in the open we find that they make strong lateral growth, and such trees do not make good timber. Mr. Prince has his trees thirty-six feet apart and some of the trees are now nearly touching. The author would recommend the proper distance to be from fifty to sixty feet apart. Under some conditions he might plant the trees thirty feet apart and later take out every other tree. Eventually five to seven trees to the acre would be sufficient, and the yield from these would be from three hundred to a thousand pounds, which, at present prices, would bring handsome profits. In some cases it might be profitable to plant these trees as Mr. Prince has done, putting them out in his prune orchard, and later, as the trees begin to crowd, removing the prunes. See plate 7. Just what trees should be removed would depend, of course, upon how close they were planted; but aim so as to have at least fifty feet between the trees permanently. To be convinced that the walnut responds to tillage and cultivation, one needs only to visit those orchards in which such care has been given, and then notice trees of the same age that have been set out and neglected. The walnut is a rapid grower and a heavy feeder and should receive the same intensive culture that is given to our fruit trees. The soil should be plowed or disked in the spring, and as soon as it is possible to get on the soil after the rains of winter without danger of puddling, it should be cultivated to a depth of two or three inches with some kind of cultivator or harrow. The underlying principle of this is simply to conserve the moisture. The moisture can be made to come up through the trees and be given off through the leaves and not allowed to escape into the air from the soil. Take a pan of water and place some glass tubes in it. You will find that the water rises in the tubes higher than it stands in the pan. Little particles of soil form just such tubes, which, reaching to the water table, cause the water to rise. By shallow cultivation we break off the tops of these tubes and do not allow the water to escape up through the ground. The function of water is principally to dissolve the plant food so that it can enter the roots and be taken to the leaf, where it is manufactured into building material, and the water is sent off into the air. Tillage should be carried on thor-

oughly during the summer months up to about the first of August, when probably in most cases the weeds can be allowed to grow. In most cases vetch can be sowed at this time. This will be plowed under in the spring, never being allowed to reach a height greater than two feet, if possible. This vetch adds a great deal of plant food, namely, nitrogen. It also produces humus, or decaying vegetable material, which helps the soil to hold more moisture, and which is of value in placing the soil in a better physical condition. If you break open a large lump of soil, you will generally find that it will fall apart along certain lines, and these lines are little fibres of vegetable material. A good supply of decaying plants on the ground will cause the soil to break up easily. It may be that in some cases, where the vetch is put in every fall, we shall get too strong a growth of tree. When this takes place, sow some such crop as rye, which will produce the humus and mechanical effects without adding much to the plant food. On some of the steep rolling land where there is great danger of loss from washing of the soil, it might be advisable simply to stir a small area around each tree, leaving the greater part of the soil in sod, and from time to time mowing the grass, allowing it to remain on the ground; but never remove it. Otherwise we cannot save the moisture in our long, dry summer. It would probably also be necessary to add extra straw to spread on the sod to conserve the moisture. We have yet to experiment to determine the value of this practice. While, in some conditions, it works well with apple orchards, we have yet to demonstrate its utility in our climate. But we do know that with good tillage plus the use of cover crops we obtain splendid results. Clear tillage alone in time destroys the humus. The methods to employ will in time demonstrate their true value and we shall probably find that local conditions will be the factors that will determine method.

PRUNING.

The walnut will require little or no pruning. Care should be taken the first four or five years to keep nearly all laterals removed. This will cause the tree to make a rapid terminal growth, and when the laterals do begin to grow they will not come down close to the ground as is the case with the young trees where the laterals are allowed to remain (plates 9 and 10), necessitating the cutting off of quite large limbs. This keeping the laterals off also, of course, gives a much larger tree, as the growth that would naturally go

into the laterals is forced into the terminal growth, the young tree sometimes making seven or eight feet of growth in one season. The young trees should always be staked and tied with broad strips of cloth to prevent cutting. Plate 8 shows a three-year-old tree properly treated. From time to time dead wood will need to be removed from the tree and occasionally a few limbs taken out to guard against having the tree grow too thick; but care should be taken not to remove large limbs. When this is done be sure to make a slanting cut so as to shed the water, and then wax it to keep it dry, as exposed pith will rapidly decay. It has been the practice in some places, in harvesting the nuts, to handle the trees more or less roughly, it being claimed that the breaking of certain terminals forces out a lateral bud growth; and it may be that in some cases where the trees do not tend to be very fruitful the heading in of some of the terminals may be beneficial. We still need to do more or less experimenting along this line, but the walnut grower will find that his trees do not all begin fruiting at the same age. Here in Oregon the average is from four to ten years, but some trees that are considered to be barren at ten years old, later come into bearing. The yield of nuts the first year is very light—probably four or five nuts to the tree. The second year, two to five pounds; and trees from fifteen to twenty years old yield as high as three bushels on the average, while old trees yield from fifteen to twenty bushels. The walnut, if given proper treatment, will live to a ripe old age, as we know of trees in parts of Europe that are three hundred years old; but some California trees have been removed when they were thirty years of age, it being claimed that they had outlived their usefulness. This was probably due, in every case, to too close planting. When proper distances are allowed and the air circulates freely in among the trees, they live naturally for centuries, and this is one of the most attractive features of the walnut industry. In establishing orchards we are laying the foundations for prosperity for a great many generations.

HARVESTING.

The nuts are not harvested until fully ripe and the husks begin to split open. Light shaking of the trees will then cause most of the mature nuts to drop. As the walnut does not ripen uniformly, it will be necessary to gather the fruit at intervals for several weeks. In some countries it is the practice to beat the fruit off from the

trees but the California growers believe that this is more of an injury than a help as it often seems to knock off a great many buds. With care, however, a long, light bamboo pole may be of some service. When the nuts are gathered, the husks should be removed and the nuts washed and rinsed, for, if the hulls are allowed to remain on the nuts, they will cause a staining, thus depreciating the market value of the nuts. Where only a few nuts are grown, probably the husks can be removed by hand; but where nuts are grown on quite a large scale it may be necessary to make some kind of barrel or drum in which the nuts can be churned. One of these can be easily made by taking a common water barrel and making an opening on the side through which the nuts can be put in, and then revolving the barrel on some form of axis. In some cases it is the practice to add a little sand, and in France it is sometimes customary to give them a soapstone polish, which makes the shells very smooth and gives them somewhat of a greasy feeling. After the nuts are washed they must be cured. This curing is a matter that requires a good deal of care. The nuts are generally placed on platforms or trays—prune trays will serve admirably. (See plate 12). They are then allowed to remain out in the sun until properly cured, which will take about three days. It will be a good plan to stir the nuts several times each day, and, where they are left out at night, to have some kind of covering of canvas to throw over them to keep away the dews. In some cases they are dried by artificial heat, being placed in a temperature of at least one hundred degrees Fahrenheit for a number of hours, depending, of course, upon the degree of heat. After the nuts are cured they should be placed in a rather cool, dry atmosphere, where they can be kept until shipped. If not cured and kept in good condition the nuts will become ransid and be unsaleable. It is the practice in some parts of California, and also abroad, to bleach the nuts by means of sulphur. This practice, while whitening the shell, causes the quality of the nuts to deteriorate. If insisted upon by dealers, this may have to be done, but growers should try to discourage the practice. Some time ago the California Agricultural Experiment Station suggested the following treatment:—"The nuts, placed in small baskets such as the Chinese use for carrying, are dipped for about five minutes in a solution containing to every fifty gallons of water six pounds of bleaching powder and twelve pounds of sal soda. They are then rinsed with a hose and, after draining, again dipped into another

solution containing one per cent. bi-sulphide of lime. After the nuts have assumed the desired tint they are again rinsed with water and then dried. Instead of the second dipping, the nuts may be sulphured (fumigated) for ten or fifteen minutes. The cost of fifty gallons of chlorine dip will be about forty cents; the same bulk of the bi-sulphide dip, probably considerably less. The time occupied in handling one batch, two dips, is from twelve to fifteen minutes."

MARKETING.

The walnut is generally marketed in sacks. These hold from one hundred to one hundred twenty pounds. The more progressive growers screen the nuts, assorting the different sizes, as the prices range more or less according to size. The Chaberte nuts, however, and some soft shelled types, cannot be sacked, as the shell is too thin to warrant rough handling. These nuts are crated. With the reputation that we have established in the packing of fruit, we have a standard, in a way, to follow in handling the walnut. In other words, there will probably be a market for the better grade of nut handled in attractive packages. As the tendency is for small gift packages of fruit, so it will be with the walnut, and attractive packing and packages will undoubtedly bring splendid returns. In the countries where the walnuts are being grown in large quantities, quite a number are being picked green for pickling and catsup manufacturing. There is also quite a demand for walnuts for manufacturing oil and probably some inferior nuts could be used in this way to advantage. One hundred pounds of nuts will manufacture about eighteen pounds of oil. The French use this oil in manufacturing "olive oil".

VARIETIES.

The question of variety is one every grower must solve. At the present time there is practically only one point on which all growers unite in regard to varieties for Oregon, and that is, they must be the late-blooming kinds, known as the French varieties, such as Mayette, Franquette, etc. (See plates 13 and 14.) Each nut has its champions, but the two varieties named are the general favorites. Time alone will settle the supremacy of any variety or varieties over others; but it is only reasonable to suppose that the walnut, like the apple, will demonstrate that each variety is adapted to certain conditions, and fills a valuable place either commercially

or as a home nut. Already certain characteristics are being associated with each variety—thus, the Proepurturien bears while very young and the nut is of fine quality, being an excellent home nut. The Chaberte seems adapted to high altitudes and poor soils, and the kernels separate easily. The Franquette is noted for its good size and prolificness; the Mayette, for extra good quality; and so on down the list. These nuts also have their weak points, which will be brought out in the descriptions following. Not only do I expect to see each variety establish itself in some one of our varied conditions, but I also look for more varieties,—for seedlings superior to anything we now have. Already we see such signs in the seedlings shown in Plate 20, which were found in the orchard of Mr. Prince, and which have some excellent characters. The nut shown in Plate 16, Fig. 5, is a seedling, evidently of the Franquette, found at Salem. It is large, of fine appearance, but the shell is a little thick. Again, we can improve the varieties we already have by selection. They already show improvement over the foreign nuts in both size and flavor. Our nuts are now being sought for by the fancy grocers, being considered the best nuts on the market. Let us give these varieties a fair show, and time will demonstrate their value.

FRANQUETTE.—Originated by M. Franquette in the early half of the last century; a large nut, rather oblong, being pointed at apex and slightly flattened at the base. The valves formed by the joining of the two halves of the shell are very pronounced, bulging out to the extent that the nut can be lifted by the appendage. Passing from apex to base are suture lines, giving the nut a more or less ribbed appearance. The veining on the shell is not very pronounced. Shell, medium to thin, not being as thick as that of either Mayette or Parisienne, but being at the same time well sealed and thick enough to ship well. The inner partition shell separating cotyledons is thin and separates easily from the kernel. The kernel is plump, filling the shell and fitting rather closely along the valve lines, thus not allowing as easy separation of meat from shell as with either the Mayette or the Parisienne. The pellicle is pale yellow and glossy and is pronouncedly veined. The convolutions are quite large and coarse. The quality is excellent, having a rich, nutty flavor. The Franquette seems to show a tendency to be uniform in size and shape. It is a late bloomer, very hardy and prolific, and thus far has shown a tendency to be free from diseases. (See Plate 15).

MAYETTE.—An old, standard French variety that has been in cultivation for a long time. It is the Grenoble nut of commerce, and comprises fully half of the French crop. It is often spoken of as a medium to small nut, but this, I think, is due to the fact that we have, to my knowledge, no isolated grafted orchard here on the coast from which we can select seed, and much of the seed obtained abroad has been inferior. Again, we sometimes find nuts sold as Mayette which are not. Plate 18, Fig. 5, shows a nut sold in Salem as Mayette, but which is not. The true Mayette is above medium, to large, in size. In fact, some of the largest nuts I have collected in Oregon are Mayettes. In form it is not so oblong as Franquette, but slightly broader, and flatter at the base and more blunt at the apex. It is not ribbed as pronouncedly, but the veins are more prominent. Very deep pits occur in the region of the valve, which is less pronounced than with Franquette. The shell is somewhat thicker, the kernel large and plump, separating very easily from the shell and from the cotyledon partitions. The pellicle is dull and of a light brown color. The convolutions are not so large as with Franquette but are more numerous and more sharply pointed, while the veining is less pronounced. In quality, it is of the very best, being a dessert nut of the highest quality and bringing the highest price in the market. Fuller, in his description of this nut, states: "It is very large, with a light colored shell of moderate thickness, kernel plump, readily extracted whole, sweet and rich nutty flavor. Tree blooms late and is very productive. An old and standard French variety." At the present time we have very few genuine Mayette trees in bearing in our state. (Plate 17)

PARISIENNE.—Named after the city of Paris, but was originated in southern France and is now quite extensively grown in that country, and, with Mayette and Franquette, forms the bulk of the crop. It is a large nut of about the same size and proportions as Mayette but is more truncated at apex and does not bulge out as much in the center. It is sometimes slightly ribbed, and the pits, while numerous, are shallow. The valves are not pronounced. The kernel separates very easily from the shell. The pellicle is very light—from a straw color to nearly white. The convolutions are much as in Franquette and veins are quite pronounced. The kernel is smaller than that of either of the aforesaid nuts. In quality it is very good. Those who have seen this nut in the Prince orchard at Dundee are very much impressed with it, altho Mr. Prince himself

is as yet not sure that it can rank with Mayette and Franquette. These three nuts are promising from a commercial standpoint. (Plate 19).

CHABERTE.—Named after its originator. A medium sized nut, very flat at the base, and at the apex pointed in much the same way as the Franquette. The shell is thin, often to such a degree that it will not stand shipping in sacks, but must be crated. The kernel is smaller than that of the three above described nuts, but of about the same color as that of Mayette. It separates very easily from the shell, and this fact, with the small size of the kernel, makes it a favorite with confectioners. In quality, the meat is rich flavored and oily. Because of the large percentage of oil, it often is grown for this purpose. It is the hardiest of our French varieties and has grown at an elevation of twenty-seven hundred feet. It will also thrive on poorer soil than most of the other varieties. (See plates 13 and 14.)

PROEPURTURIEN.—Named because of its precociousness. The nut ranges in size from medium to small. In form it is something like a small Franquette, without the pronounced valves. It is a vigorous dwarf variety, often bearing in the third year, but only the grafted trees keep these characteristics. The seedlings tend to revert to the larger, less precocious, tree. In quality it is very fine and makes an excellent home nut. It is free from disease and is productive. Mr. Felix Gillet has introduced two improved strains, namely, the Large Pointed, and the Late, Proepurturien. (Plate 20, Fig. 4.)

MEYLAN.—A French variety that originated near the village of Meylan and is quite extensively grown in that region. This is a large nut, flatter and slightly broader than Mayette. The pits on the shell, however, are not so pronounced. Quite recently introduced into America by Felix Gillet. This nut can be seen growing in the orchard owned by Mr. Prince and is a very promising nut, being smooth and of fine form. It is somewhat lighter in color than most nuts. (Plate 13, Fig. 2.)

PARRY.—Medium sized, being rather flat on the base. Very few are as yet grown in our state but it may prove to be of value. (Plate 13, Fig. 4.)

Besides the English walnut we also have several other species that are useful chiefly as ornamentals or shade trees. The American Black (*Juglans nigra*), the California Black (*Juglans Califor-*

nica), one of the Japanese nuts (*Juglans Sieboldiana*), and *Juglans Manchuria*, are shown in Plate 21. There are also several cut-leaf and hybrid varieties that are ornamental and which may prove to be of value for stocks. (Plate 21.)

DISEASES AND INSECTS.

So far, in our climate, we have had few complaints of insects attacking the nuts or foliage. However, there are in some regions certain caterpillars that attack the foliage. These can be easily treated by spraying with some arsenic poison. The nut in commerce often seems to be wormy and attacked by weevils, a condition which can be overcome by fumigating; but we have practically no destructive insects with us at present. We have one bacterial disease which is beginning to show itself and which is quite prominent in parts of California. It has attacked a few Oregon orchards in a light way. This is the Bacteriosis. (Plate 22.) The organisms of this disease winter over in diseased tissues of affected branches, and in fallen nuts. New infection will often occur in the spring, attacking young shoots, nuts, and opening leaves. If shoots are tender, canker-like spots appear. Black spots form on the leaves, which become misshapen and fall off. If the nuts are attacked early in the season, they will drop; if later in the season, they become marked by sunken black spots and will often remain on the tree until late in the fall. As yet but very few trees have been attacked in Oregon and the disease may never prove dangerous. In California, winter spraying with Bordeaux has proved beneficial. The disease seems to work more upon very rapidly growing trees; and therefore, if the disease appears in an orchard, it will be well not to try to force the trees too rapidly. Destroy all diseased branches, fruit, and leaves.

At times moss and lichens gather on the young trees and a winter spraying of Bordeaux or lime and sulphur will remove this. Occasionally nuts are sunburned. This is generally due to lack of moisture or a lack of thorough cultivation of the soil. In some cases nuts are being sent to the station, which are supposed to be diseased, having sunken black places on the hull. When examined, it is quite often found that these nuts are improperly pollinated.

THE WALNUT MARKET.

Some persons have shown more or less alarm in regard to the walnut market, claiming that it would be very easy to overstock it. Now nuts are becoming more and more a staple of diet with the American people, due to several reasons—our increase in wealth, and the scarcity and increase in price of meat. The outlook now for beef is that it will tend to rise in price rather than to lower, and as our population increases the tendency will be for us to eat more and more fruit and nuts. The author of the bulletin can quite clearly remember when nuts were found on the table only at festive times; while at the present time the tendency is to have nuts nearly the season through. This means a great demand, and the figures given by the Government bear out this increase. In 1902 there were imported from Europe into the United States nearly twelve million pounds of walnuts, while in 1905 this figure had risen to over twenty million. These imported nuts are inferior to the nuts that we can grow. They are not graded as carefully. Plate 23 shows typical nuts taken from a pound of walnuts sold in one of our stores. Many of the nuts are not true to name, being a grand jumble of varieties. In California the production is increasing but slowly—less than four thousand tons in nine years; and it has been estimated that if it should double that amount in the next ten years, or, say, if the increase should be a thousand pounds a year for the next twenty years, that would mean only forty million pounds, or less than one-half pound for every person in the United States. This means that the population of the country is increasing more rapidly than the combined ratio of imported and native nuts. Again, let us consider the prices that California has realized. We find upon investigation that the price has steadily advanced. In 1896, seven cents was paid; in 1903, twelve and one-half cents; in 1906, thirteen to twenty cents. Even at the lower figure an orchard in full bearing would yield good profits, considering the amount of labor necessary, as at least six hundred pounds of nuts could be expected from an acre. It has been estimated in California that even a yield of three hundred pounds an acre would be profitable.



• Plate 1.—View on estate of Mr. Thomas Prince of Dundee, a field of 45,000 seedling walnuts from imported nuts planted last April, photograph taken in October.

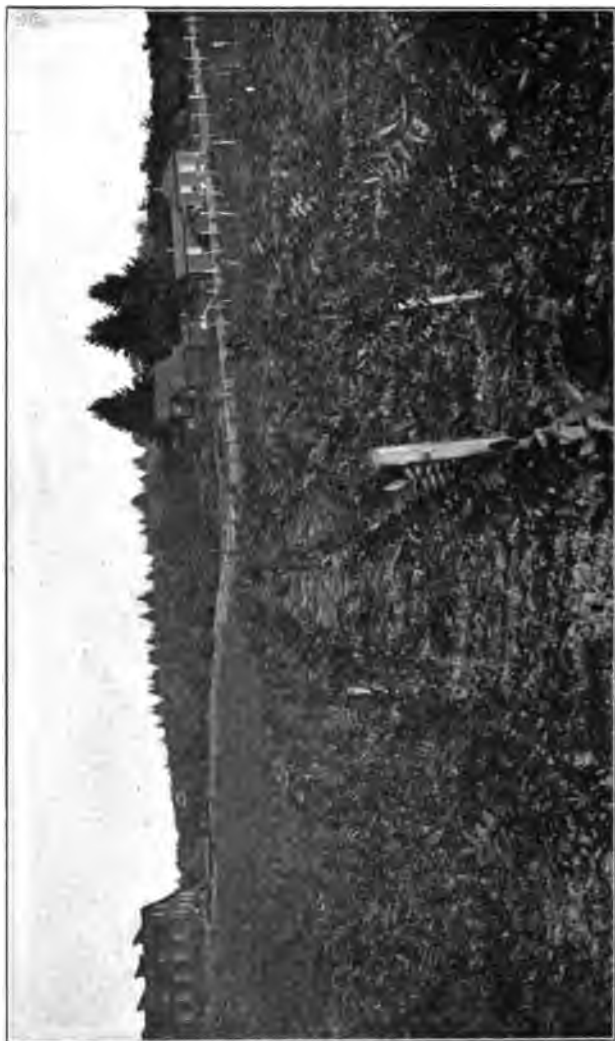


Plate 2.—A field of young California black walnuts on the Prince estate.

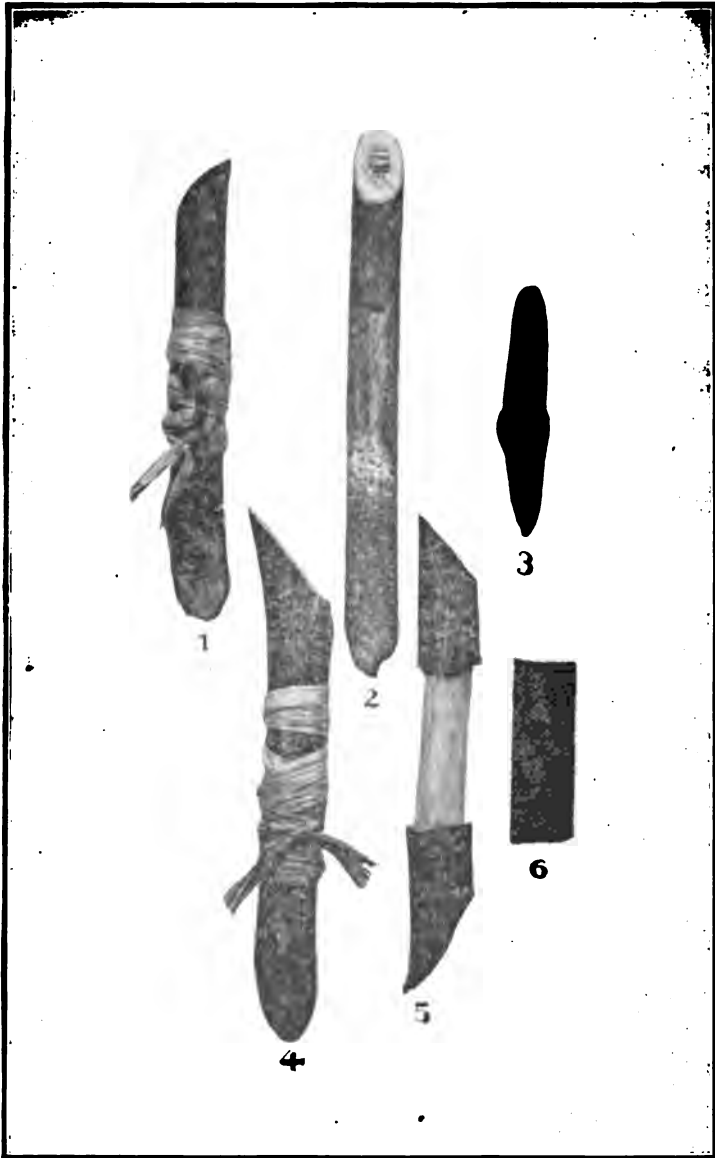


PLATE 3.—1-3 Shield budding. 4-6 Flute budding.



Plate 4.—Cleft grafting. Two cuts thru the sap wood when larger stocks are used is to be preferred.



PLATE 5.—1 English Walnut (*Juglans regia*). 2. American Black Walnut (*Juglans nigra*).

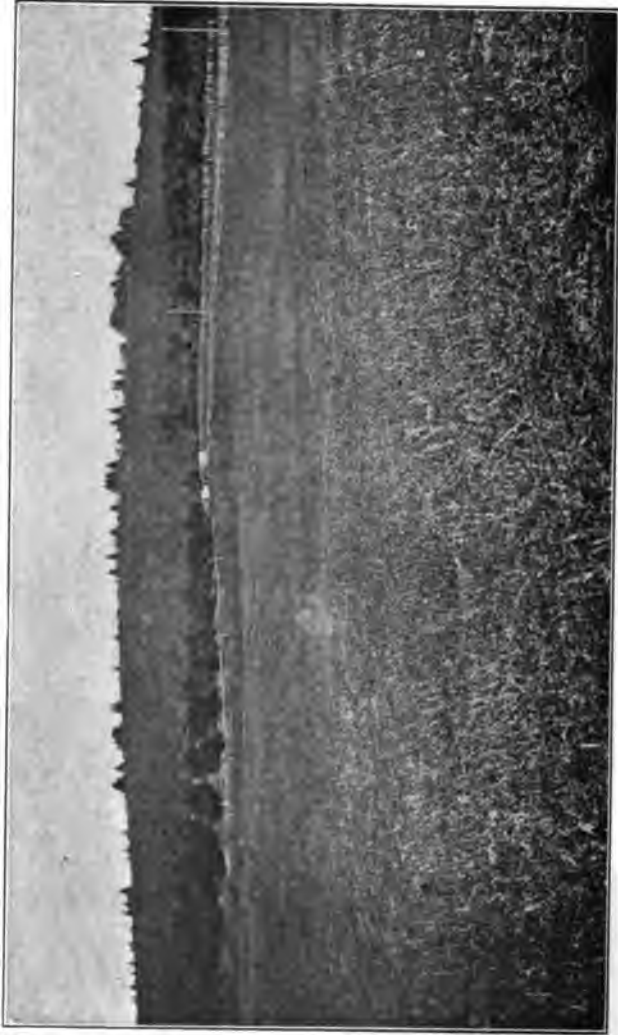


Plate 6.—A view of the Prince orchard showing nature of the site.



Plate 7.—View in orchard of Mr. Prince showing arrangement of walnuts and prunes. Every other row is set to walnuts. Every third or fourth row would be better thus allowing 50 feet between trees.



PLATE 8.—A typical 3 year old tree in the Prince orchard. Note that laterals are not allowed to grow, thus producing a strong terminal growth.



Plate 9.—This tree is headed too low, succeeding crops will bring the lower branches to the ground.



PLATE 10.—A well formed tree in Prince Orchard. Note that the lower branches are started high and trained upward.



Plate 11.—General view in Prince orchard, fine form of trees at eight years old, but they are too close.



Plate 12.—Nuts curing in the sun.

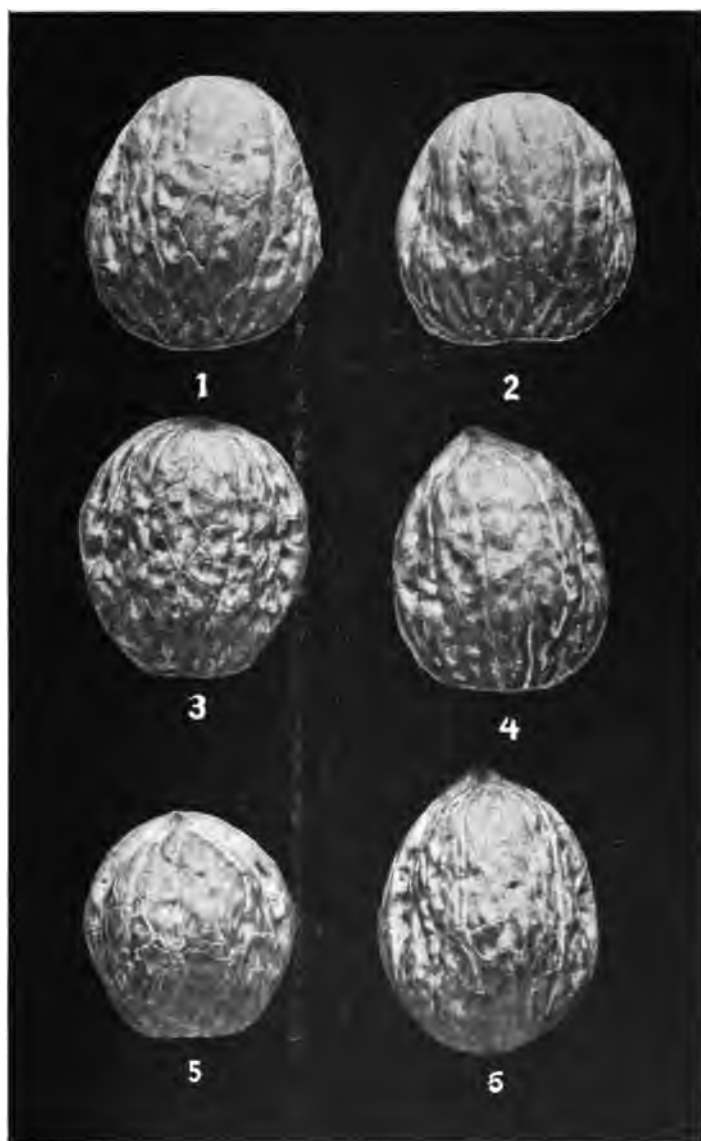


Plate 13.

1. Mayette. 2. Meylan. 3. Parisienne. 4. Parry. 5. Chaberte.
6. Franquette. Natural size.



Plate 14.—1. Mayette. 2. Meylan. 3. Parisienne. 4. Parry.
5. Chaberte. 6. Franquette. Natural size.

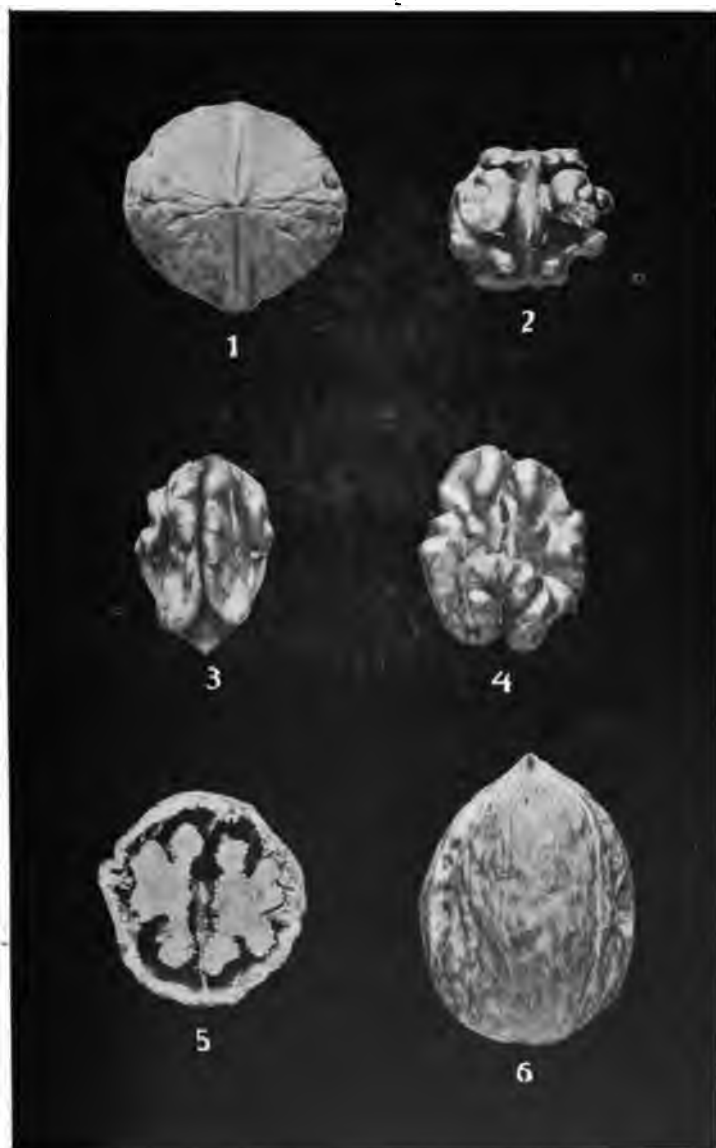


Plate 15.—The Franquette. Natural size.



Plate 16.—1-2 Oregon Franquette. 3-4. Imported Franquette.
5-6. Seedling found at Salem, probably from Franquette.
Natural size.



Plate 17.—The Mayette. Natural size.

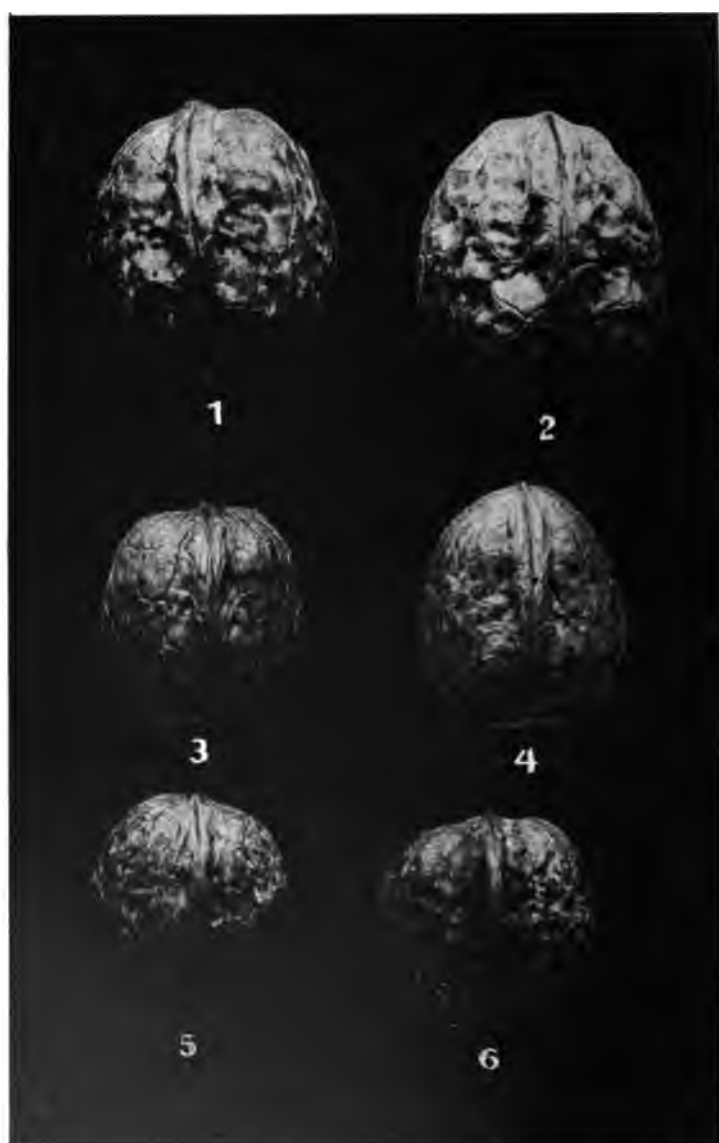


Plate 18.—1-2. Oregon Mayette. 3-4. Imported Mayette. 5-6. Nuts sold as Mayette, but which are not. Natural size.

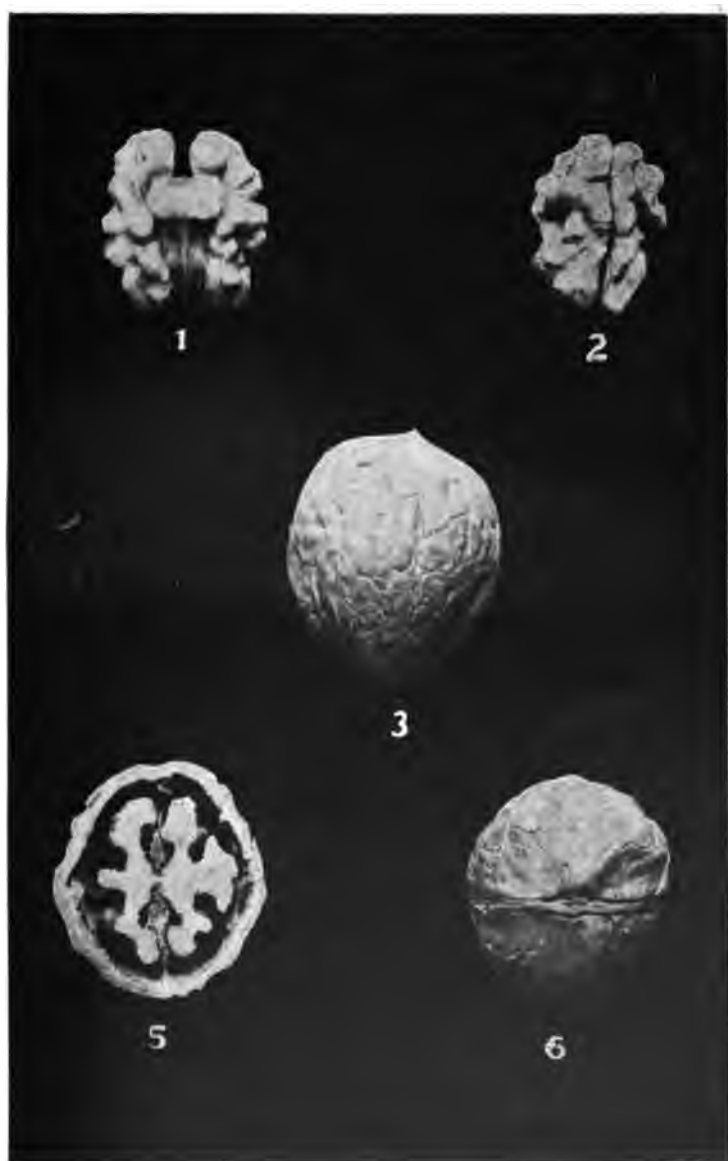


Plate 19.—Parisiene; number 3 slightly undersized.

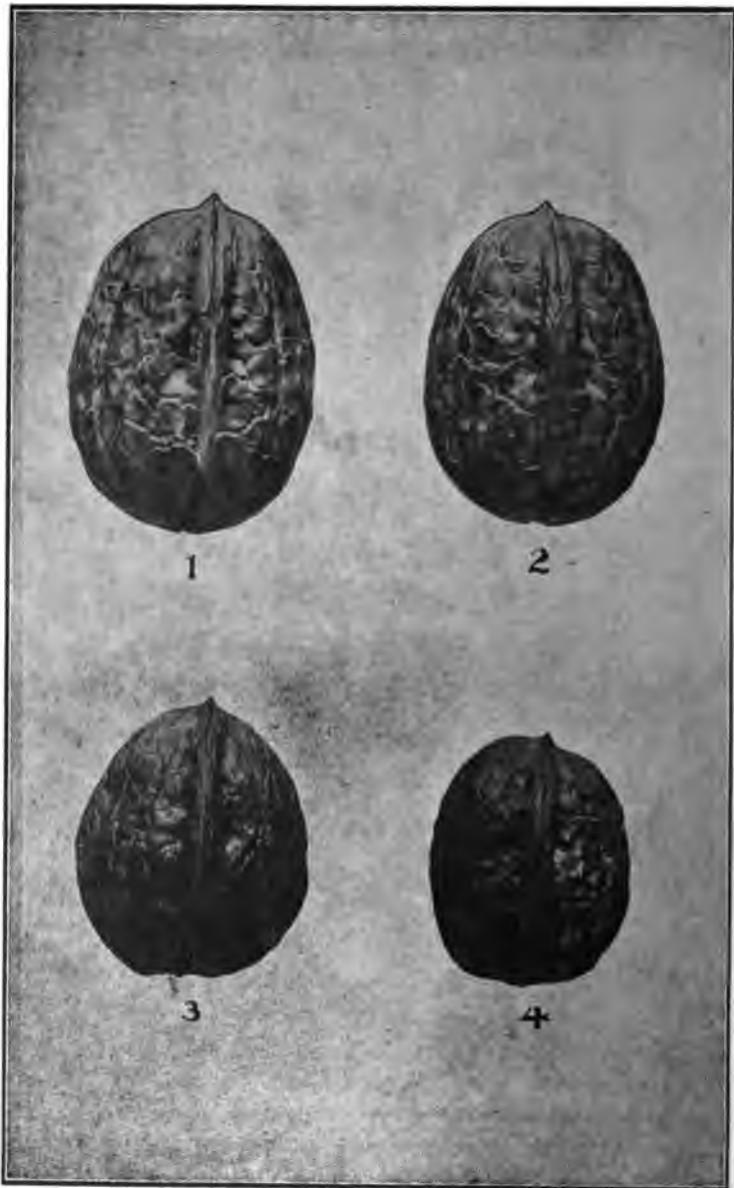


Plate 20.—1-2. Seedling from orchard owned by Mr. Prince. 3. Seedling grown by Mr. Britt. 4. Proepurturen. Natural size.

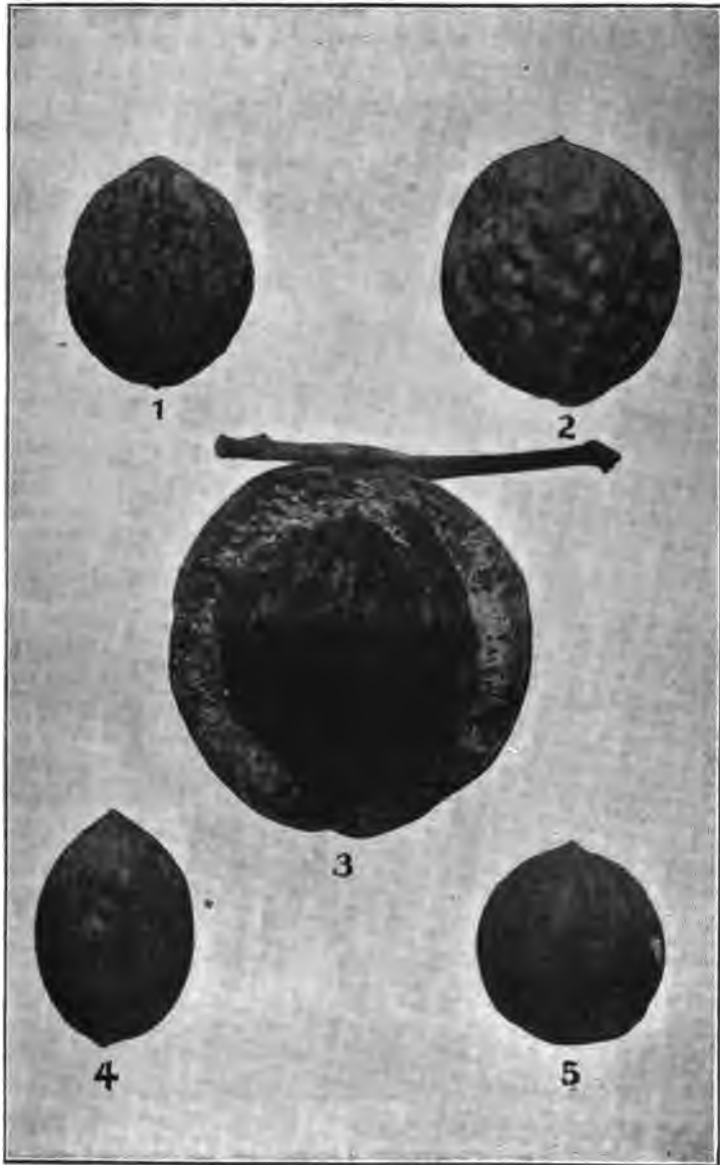


Plate 21.—1. *Juglans Nigra*. 2. *Juglans Manchuria*. 3. *Juglans Nigra*.
4. *Juglans Sieboldiana*. 5. *Juglans California*. Natural size.



Plate 22.—A diseased tree. The appearance of a tree attacked by Bacteriosis.



Plate 23 —Six nuts taken from one pound of nuts as purchased at grocery. Natural size.

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Department of Horticulture.



Oregon Agricultural Experiment Station.

CORVALLIS, OREGON.

ORCHARD MANAGEMENT

By C. I. LEWIS and W. H. WICKS.

**THE BULLETINS OF THIS STATION ARE SENT FREE TO ALL RESIDENTS
OF OREGON WHO REQUEST THEM.**

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INTRODUCTION.

This bulletin, entitled "Orchard Management," is not intended to put forth and explain some new and wonderful discovery or achievement in the domain of horticulture, but rather to thoroughly explain the management of important fruits and assist the large class of deserving people who are now beginning to realize and appreciate the value of fruit-growing as a sound lucrative occupation.

The fruit industry is rapidly enlarging and becoming of great importance throughout the Pacific Northwest and more particularly the fertile State of Oregon. Altho the price of our various fruits and particularly apples, is not as high as that which Mr. Leulling received for his first apples which he sold in Portland in the early fifties, yet nevertheless, there is a neat profit in raising fruit at the present prices.

Almost ninety-five per cent of those people who have just begun or intend to begin raising fruit in this state are those who are leaving their original profession. Consequently, we are receiving letters of inquiry at the experiment station from men who have not the first principles of fruit-growing, and those with the rest of the industrious people of the state are the ones this treatise is intended to assist. The questions asked are so various that it is thought best to answer them by printing a general simple bulletin that everyone can understand, and it is hoped will fulfill the apparent need.

The word orchard is very broad in its meaning and will admit of further explanation. By orchard we mean a group of trees planted and cultivated for their fruit. Thus, we have an apple, peach, plum and pear orchard and any other combination of fruit-producing trees that may be grown. This work will treat of pomaceous fruits such as the apple and pear.

The prospective fruit grower will appreciate a few remarks in regard to the price of fruit land, the prices of the various fruits, and the adaptibility of our state to growing the different kinds. We think at the present time there is hardly five per cent of the suitable land in Oregon in use for raising fruit. The tabulation of the fruit districts and the fruits that do well in them will throw light on this subject, but the world must know that more fruit land is lying idle

in this state, particularly in the Willamette valley. Most all of our foothills could be successfully put in cultivation and upon a suitable subsoil, the apple, pear, peach, and grapes will grow to perfection. The Hood and Rogue river valleys have become famous, and the Willamette valley will be second to none when her people wake up and improve the splendid opportunities which lie before them.

The land here in large tracts, which is producing goat pasture and selling at the present time from twenty to fifty dollars per acre, should be put into suitable fruit and be worth from five to twelve hundred dollars per acre. There is nothing worth while in this world which does not cost an effort. There are difficulties incidental to all progress and the fruitgrower must be determined to meet and overcome them. The success of a man is usually determined by himself, and if the right spirited tiller takes charge of our soil, it will undoubtedly do its part in return.

We may here give to some advantage the profits and yields of some of our leading horticulturists of the state. In Southern Oregon there are thirty-five acres of Spitzenberg apple trees fifteen years of age which bore from thirty-seven to thirty-five boxes of three-and-one-half tier apples per tree. The net receipts of this crop was some better than \$8000.00. On another farm in the same vicinity, an acre and one half produced twelve hundred boxes of apples which sold for \$2.00 per box, making a profit of \$1,520. A carload of Southern Oregon pears sold last winter in the East as high as \$3.00. The Hood River Apple Growers' Union sold their apples this year a little better than \$3.00 per box. It must be well understood that the fruit is first-class and made so by proper management.

LOCATION AND SITE.

LOCATION.—The question of location is very difficult to answer satisfactorily, but a few remarks here will serve as a guide. The reader must always remember that the location must be chosen by himself. The location is the position of the place fixed by the surveyor. It may lie in any one of the various fruit regions, and is generally governed by the distance from shipping facilities, as the market may be reached no matter how far away. Bear in mind when choosing a location that the nearer the market the better, providing other things are equal, and secure several means of shipping if possible. If fruit is grown in small quantities and for fancy trade, it

is better to be close to the market, but if it is grown on a large scale for commercial purposes it may be grown further from the market, as our present day methods of transportation have overcome distance, but locate as near as possible to shipping points. The cost of land must not be too important in choosing a location if the desired location will produce your ideal crop. In order to grow the



Fig. 1.—Windbreak greatly needed. Only by the most judicious pruning can these trees be balanced, and then only with great difficulty. Staking would have helped many of these trees.

best fruits, you must choose those that will thrive best under the conditions of the locality. Facility of tillage and climatic conditions are very important in choosing your location, To sum up briefly the subject of location, choose a fertile soil which should be deep, well drained and good body or texture, near two or more shipping points, and a suitable climate.

SITE.

AS TO SOIL.—The site of the orchard is an important question and is governed by conditions that prevail in certain localities. The following points must be observed: Texture and kind of soil, supply of soil moisture or facility to irrigate, air and soil drainage,

wind-breaks, direction of slopes and distance from large woods.

The above terms will need more explanation before they are of any practical value to the man who is not acquainted with agriculture. There are many kinds of soil and our various fruits prefer their respective soils. We know that the apple likes a well-drained, deep rich soil, while the pear prefers a more heavy clay loam but likes to be well drained. The peach does best in a well-drained gravelly or decomposing rocky soil with a deep subsoil. In choosing land be sure not to have an ideal soil in one part of your orchard and a hardpan or impervious strata in another. If the soil is not rich, deep and satisfactory in every way, do not purchase it.

The soil moisture requires further explanation, but will receive more under the subject of "soil." The air drainage of an orchard is very important, as this is in relation to frost. The cold air settles in the valleys and low places and if the orchard is in the warmer and circulating strata of air it will often escape dangerous frosts. Water gives up its heat slower than the earth and orchards that are near it will be more or less protected from cold. The subject of soil drainage will be treated under its proper heading later.

The wind-break has proven itself exceedingly useful and there are many points in its favor, yet there are those who do not think favorably of it and will not tolerate one on their soil. Fig. 1 shows conclusively the need of an ordinary wind-break that can be obtained by planting any of our native conifers. Some very good reasons for a wind-break may be stated thus: It protects from cold, reduces evaporation of the soil, prevents breaking of trees by wind, lessens windfalls, protects blossoms, retains the loose surface soil and is a home for beneficial birds. There are some objections to the wind-break, which, however, need to be spoken of here in order to place your wind-break in its proper relation to the orchard. If the fruit trees are too near it, the fruit will be poor in color and generally covered with rust and more or less infected with insects. For warm, strong winds use poplar, maple, etc.; for cold winds the conifers, such as fir and spruce; seedling fruit trees, as Fig. 2, may be used, but must be kept sprayed. The alder and several other of our native trees furnish food for the tent caterpillar and several diseases. The more our natural forests are cleared away the more



Fig. 2.—Effective economical wind-break. A wind-break may be grown with very little trouble and expense. This wind-break takes very little room and does not take much nourishment from the soil.



Fig. 3.—Permissible in a young orchard but the crop is somewhat too heavy. Never grow grains but garden truck may be grown if necessary.

wind-breaks will the horticulturists be compelled to plant. We cannot change and control atmospheric conditions, but we can moderate them to a certain degree. Fig 2 shows an effective economical wind-break of apple, plum and quince seedlings.

As to ASPECT.—The exposure or aspect is determined by the direction and slope of the land. The temperature of the soil and air is greatly influenced by the aspect and is a direct factor in growing the tender and early blooming varieties. If possible select a site that has a natural soil and air drainage. The excess of cold air and soil moisture must be carried from the orchard. The need of air drainage is apparent if we go from the top of a small hill to the valley and notice the difference in temperature. The colder air always settles to the low places, and consequently frost is more frequent. If you are to grow fruits that blossom early and must be protected from late frost, then a northern aspect is much to be preferred, but always remember a southern aspect is much better providing the late frosts will not bother in your locality. Those varieties that take on high color must be planted where they will receive the most sun. Always avoid small valleys with a creek running thru, as the cold air will accumulate in such places, and frost will do considerable injury, but large bodies of water are beneficial.

"Deep valleys with small streams of water are the worst situations for fruit trees, as the cold air settles down in these valleys on a calm frosty night, and buds and blossoms are very frequently destroyed. We know a rich and fertile valley of this kind in Connecticut where the cherry will scarcely grow and a crop of apple or pear is not obtained once in ten years, while the adjacent hilltops and high country a couple or three miles distant, yield abundant crops annually."—*Downing's Fruits and Fruit Trees of America*.

SOIL.

The soil must have a good supply of humus and if possible some cover crop growing on it to be turned under. We must keep the land at work and not allow it to be idle, as was the general opinion a few years ago.

The amount of plant food which mature fruit trees in the full vigor of bearing use in one growing season has been reported by L. L. Van Slyke, O. M. Taylor and W. H. Andrews of the New York State Station. The apple trees in the experiment yielded during the season from twenty-three to nearly thirty bushels of fruit each, the pear trees, from one to five bushels each, the plum, from one to

one and three-fourth bushels each, and the quince trees about fifteen bushels.

Variety.	Lbs. Nitrogen.	Lbs. Phosphoric Acid.	Potash.	Lime.	Magnesia.
Apple.....	1.47	.39	1.57	1.62	.66
Peach.....	.62	.15	.66	.95	.29
Pear.....	.25	.06	.27	.32	.09
Plum.....	.25	.07	.32	.34	.11
Quince.....	.19	.06	.24	.27	.08

In our climate most all fruit trees will thrive and produce some fruit, but as before stated, each fruit prefers its own peculiar soil.



Fig. 4.—Common method of budding.



Fig. 5—1, 2, 3 desirable scions, 4 and 5 undesirable; 4 terminal growth, and 6 water sprout. The last two should never be used.

The soil best adapted to general fruit culture may be classed or divided into gravelly loam, sandy loam, strong black loam and clay loam. Very light sandy soil, wet swamp and peat soil or dry sand, are generally to be avoided, although there are exceptions. For instance, in the neighborhood of Grants Pass we find a large area of light sandy loam which the observer would not consider good apple land. This land has been filled in by previous overflows of the Rogue River, but this soil produces fruit of the finest qualities. Investigation shows the reason. The soil is deep and mellow, from

fifteen to twenty feet when the water table is reached, thus supplying abundance of water. This soil is unexcelled for cultivation purposes as it can be worked while other soils are sticky and heavy. The hardier fruits usually do best on a rich, moderately heavy clay loam, and experience has shown that the apple, pear, and plum do much better on such a soil and are much more immune from diseases of various kinds. Fruit on such a soil is large, of good keeping quality, and in our climate of fine color. Fruit on lighter soil is generally smaller, of higher color, poorer keeping quality, maturing sooner but producing fruit of fine flavor and aroma.

A gravelly loam is a soil that contains gravel but not in excess. A strong loam is a soil that is rich and contains just enough sand to make it loose and easily worked. Clay loam is usually a strong and deep soil and contains just enough clay to make it more or less difficult to work. It is best to choose a soil rich in calcarious substances if the texture is good. The small fruits require rich soil and will do well almost on any soil that will produce first-class farm crops.

PREPARATION.—The first thing to do is to have the soil in a good state of cultivation so that it can give up its plant food when applied or that which it already contains. The soil should be tile-drained, if not naturally, thoroly fertilized, properly subsoiled and put in the best shape possible before any trees are planted. If the soil is deep, the trees will go deep into it, and the root system will be out of the way of the plow. The manures should be incorporated in the soil immediately, and must be placed where the rootlets can use it and not piled high about the trunks of the trees after they are planted.

DRAINAGE.

FUNCTION.—The functions of drainage are many but the following will give some of the most important reasons why land should be drained. Drainage removes the injurious salts in the earth which would accumulate in a soil with no natural or artificial drain. It removes water at those times when a surplus would be very injurious to plant life by excluding sufficient air. In our rainy season the surplus water must be carried off. In contrast to this, drainage enables the soil to hold more moisture in those times when it is most needed by the plants. In soils poorly drained the water table is near the surface in the early part of the season, and hence the

plants make a lateral shallow root growth. Later, when rains become less frequent, the water table or level falls and the plants, owing to a poor root growth, suffer in time of drouth. It deepens the soil and makes the capillary action greater, while it increases the amount of plant food by causing a larger amount of soil to give up its food when penetrated by the roots of plants. The lower the water table the more surface will the plants be able to utilize, as nitrification and those changes which unlock stored plant food take place in well ventilated soil. The physical condition of the soil is greatly improved by aiding and facilitating chemical changes. The

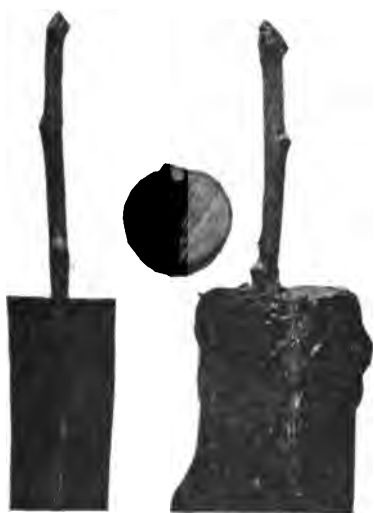


Fig. 6.—Cleft grafting. No. 1, scion inserted ready for waxing. No. 2, end view of No. 1 to show position of scion. No. 3, No. 1 waxed. Be sure to thoroly cover the wound. All things considered, the best method of top working.



Fig. 7.—Grafting chisel. This can be made out of an old file. The blade must not be driven into the stock too far.

soil is made much warmer by the removal of surplus water, and the increased temperature has a beneficial influence on plant growth. Those small bacteria which are so important are able to do much more and faster work in soil which is well drained.

Wm. P. Brooks, in his book entitled "Soils and how to treat them," says:

"Among the principal benefits which follow the drainage of soils needing it may be mentioned the following: it deepens the soil, promotes aeration, makes manures more effective, warms the soil, lengthens the season both for plant growth and for work, makes all tillage operations easier and improves the

tilth, reduces the liability to injury of crops from drought, promotes the better germination of seeds, results in the production of larger crops of better quality and decreases the risk of failure of crops, reduces the amount of surface wash, makes it possible to haul heavy loads over the field, produces better sanitary conditions, and decreases the number of mosquitoes and malarial diseases. Thorough drainage and thorough tillage are the main points in land improvement."

LAND THAT REQUIRES DRAINAGE.—There are several kinds of land which need drainage, but it can safely be stated that a large percentage of land in Oregon would be benefited by a system of drainage, and much of our so-called white land could be reclaimed if the surplus water was carried off and the land cultivated properly.

Land that is overflowed frequently by our creeks and rivers need a thoro system of under-drainage; also flat land with a heavy subsoil. Most land at the foot of hills are subject to ooze water and the overflow of springs, etc., and hence will be much benefited by drainage. In the rainy season here may be seen land where the water table is visible above the surface, and it can be readily seen that such land needs drainage. Any land that will not shed its surplus water in forty-eight hours after heavy rains needs drainage badly.

ITS EFFECT ON PLANTS.—Seeds often decay in poorly drained soil, and those that do succeed in germination have very unfavorable conditions to contend with. A fair amount of moisture, air and favorable temperature are needed for plant growth. A certain amount of water is necessary in the soil, it must be understood, but the amount above what the plants require must be carried off. The food of plants is in solution and water is the medium in which it is carried from the crude state to the useful form.

The soil particles are made much smaller by drainage, and thus the small delicate root-hairs are enabled to pass among them and secure more food. The tips of roots and root-hairs are acid and have the power of unlocking plant food in the soil and oxygen in sufficient amount is required among the particles in order for the rootlets to carry on their work. Crops are also of better quality and the valuable constituents are increased. Among the most valuable ingredients may be mentioned starch, albuminoids and sugar. It must be remembered that all conditions support their respective plant life, i. e., water-logged soil will support water-loving plants, and a well drained soil will produce the more valuable ones.

METHOD OF DRAINAGE.—There are several ways of draining a field,

but the under-drain is the only method to use in soil used for horticultural purposes. The surface drains may serve temporarily in some conditions but they are inferior to the under-drains. All sorts of drains have been used in the past but experience has proven that the tile drain is the best. Some of the other kinds are brush, cement, wood, stone and brick.

The distance between drains is governed entirely by the kind of soil and the position of the same. If the soil is more or less loose and friable, the drains may be from twenty to forty feet apart and be quite satisfactory. They will do better work if placed much



Fig. 8.—A stock of this size cannot support two scions. One would have made a strong union.



Fig. 9.—Result of two scions on a small stock. The stock is decayed in the center. Practically lost. One scion would have prevented this.

closer in heavy impervious soils. The depth to which they are placed depends upon the outlet, the slope of the land to be drained and the general conditions of the soil. The depth of the drains will govern the distance apart to which they are placed. The deeper the tile, the farther apart they may be placed, providing the soil is porous and will admit the water to the drain. From four to five and one-half feet is none too deep for best results, and the deeper the water table the better for the trees. The drains should be, in

all cases where possible, deep enough to escape being misplaced by tools, and in severe climates, by frosts.

The size of the tile is an important consideration in putting in a system of drain. Wheeler says:

"If the fall be six inches in one hundred feet, the two-inch main will carry water from three acres, and with a fall of twelve inches in one hundred feet, it will carry the water of double the above named area. Also for the more open soils, a four-inch main would carry the water from five acres, a six-inch main, the water from twelve acres and an eight-inch main the water from twenty acres, provided the fall is from three to four inches in every hundred feet. If the fall is six inches, the different sizes will carry the water from one and one-half times the above named areas. In clay soils the number of acres for the different sizes at different grades will be double those above named."

It is never wise to use larger tile than necessary. The outlet of the main drain is an important point. Much depends upon into what the main empties, but a solid substantial support is forcibly recommended. Otherwise, the terminal joints become misplaced and eventually the whole system is obstructed. If the outlet is in a stream where the water flows against it with any considerable force, build your bulkhead at such an angle so the water of the stream will not wash in back of it and eventually carry it out.

In conclusion, will say that the tile must be properly laid and all work done well.

CULTIVATION.

This is performed to better the mechanical condition and increase plant food. Tillage of the soil in the orchard is to increase chemical changes. Every orchardist has his method of cultivation. The most general practice is to plow about the time the blossoms fall, or as soon as the conditions are suitable, and then follow this with a clod crusher or disc harrow. The soil is afterwards kept with a very fine dust mulch of three or four inches deep all summer. This is very instrumental in saving soil moisture. The tools most commonly used by the best fruit growers are as follows: eighteen inch disc, smoothing harrow, leveler, clod smasher, spring tooth or acme harrow, Kimball orchard weeder, a home-made weeder to cultivate near the tree trunks, and a good plow.

It is far better to have a small piece of land and keep it under high cultivation than to poorly care for a larger area. The people in this state should dispose of a portion of their large farms and improve their method of cultivating the smaller amount. The value of cultivation thruout the dry season may be more appreciated if

explained more in detail. Suppose you place in a pan of water the end of a large glass tube and notice the rise of the water in the same. The operator will notice that the water does not rise to any



Fig. 10.—Correct planting. The properly planted orchard should look like this. These trees show beautiful symmetry and good care.

great extent. Then place in the same pan of water a very small tube in the same manner as the larger and notice the rise of water. This then is the same principle as that in the soil, that of capillary

action. The finer the ground is made, the smaller and more numerous are the capillary tubes, and thus the more moisture is carried upward from the water table. The cultivation should not be continued too late in the season, as it will induce a late growth of the trees. Cultivation should stop in late summer or early fall, and the land be sown with vetch, clover, rape, turnip or some such plants as a cover crop, to be turned under in the following spring.

COVER CROPS.

The cover crop is coming more into favor in this state. Most soils are losing their humus, through continued working and producing, and the cover crop is the ideal thing to restore them to their former condition. Before sowing a cover crop, determine what results certain plants will bring about. If your trees need nitrogen, they will show it by having light green small foliage and a small wood growth. The best cover crop in this case would be any one of the leguminous plants—preferably vetch. If your fruit lacks color add potash, sow turnips or rape, and if your soil needs some of the surplus water carried away, sow those plants that evaporate the greatest amount. The cover crop should be plowed in before it becomes too abundant as too much green vegetation does not decay rapidly and tends to dry out the soil.

WHAT A COVER CROP WILL DO.—A cover crop will catch in the fall the nitrates and other valuable plant food which would otherwise be lost in the drainage system and hold it over until the following spring for the use of the trees. It also catches the nitrates in the spring, which are apt to leach out, and takes up the excess water, and thereby put the ground in condition sooner for cultivation. The humus loosens the soil particles which in turn increases its water capacity. The humus is essential for the growth of the beneficial bacteria of the soil. One of the most important parts that a cover crop plays is its ability to change chemically the compounds in the soil and put them in an available form for the trees. The cover crop gathers, digests and turns over to the trees the plant food which it has stored.

The rotation of cover crops is earnestly advised. This is exceedingly important and must be practised in order to furnish the trees with a balanced ration. When to change the crop will depend upon what the trees lack, as some orchards need more potash than nitrogen and visa versa. Some orchards will need only the humus supplied and this is best furnished by rye. In all uses of a cover

crop make it do a definite work. Never pasture the cover crop in the orchard as the soil is usually too wet to allow stock upon it, and

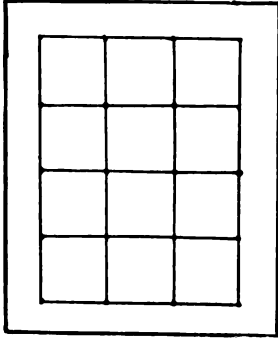


Fig. 11.—Square or opposite plan.
Not so good as Fig. 12.

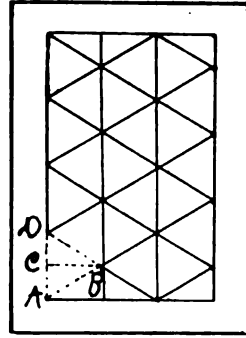


Fig. 12.—Hexagonal plan.
More trees to the acre
than by square plan.

the trees will gladly appreciate all the food they can obtain. Some argue that feeding the cover crop is profitable, but it is not half so valuable as the first-class apples at three to four dollars per box.



Fig. 13.—Close planting. *Trees eight years old and too close to admit proper care. Thirty-six feet is none too far apart,

FERTILIZATION.

The fertility of the soil depends upon so many things that it is very difficult to tell just what fertilizers to add, but it must be born in mind that poor crops in nine times out of ten are due to poor mech-



Fig. 14.—Never start the main limbs in this manner. They should issue in a whorl from eight to fourteen inches apart to prevent a bad crotch.

anical condition, instead of lack of plant food. Many of our valley soils are rich in plant food and it remains for the tiller to put it in an available form. If the soil is a heavy clay loam and allowed to become puddled and kept too wet, we can readily see that the mechanical condition is to blame, if the soil produces nothing, no matter how much plant food it contains. If the soil is deficient in any one plant food, it is almost sure to be nitrogen. This most valuable food can be added in several artificial ways—in the form of nitrates—but there are certain minute organisms that will use the free nitrogen of the air if

the condition of the soil is such that they can live. The salts of nitrogen are rapidly leached out of the soil in this climate due to a large annual rainfall. Plants use nitrogen in large quantities.

The fertilizers should be applied early or in time to help the natural growth of the orchard, and not applied so late as to cause the trees to make a late or second growth. Do not think that you must be always adding commercial fertilizers to your orchard land, but rather improve the mechanical condition, and unlock the stored up food already in the soil.

SOD CULTURE.—This treatment may be used to great advantage in some cases. Under certain conditions where the soil is exceed-

ingly rich, moist, and the trees are making too rampant a wood growth, the sod method may be used to great advantage for checking the same. Under very few conditions can sod culture be recommended for the permanent method. The orchardist must study his trees and determine what method of cultivation they require. If the sod method is chosen for a period of years, always mow the grass and leave it upon the soil, instead of putting it into the barn for hay. After the sod has served its purpose break it up and practice the most needed method. The sod method should never be used in a young orchard. The young trees need all the food possible and good care, during the first years of their existence, is absolutely essential. The growth of vegetables is permissible during the early life of the trees, but if the trees require all the food it is of course best not to use their supply by growing other plants (See fig. 3).



FIG. 15.—The result of a poorly formed head. Breaks when laden with fruit. Past redemption.

In conclusion, the orchardist cannot be too strongly impressed with the importance of cultivating his young trees in the most careful manner, and always give them the first choice and use of the food. It is observed that no orchard under good cultivation is abandoned, while those in sod are often uncared for.

IRRIGATION.

One of the most serious problems we have to solve at the present time in our semi-arid fruit districts is that of irrigation. At present many growers are meeting this problem blindly, and believe that irrigation is the only practice that can guarantee to them a full crop of large apples, the size being all gain, and nothing being sacrificed in return. They fail to make a close study of their conditions,

and because a certain fellow fruit grower who irrigates obtains wonderful results they immediately accept the general principles without realizing or studying their relation to their own conditions. Before irrigating on a large scale, be sure you need it. Many times more thoro cultivation is what is needed; and if you irrigate, remember that the problems concerned with irrigating our fruit are vastly different from those connected with cereals, forage crops, or garden truck. You must know how much water to apply, how and when to apply, and the action of the water on tree, fruit, and soil.

It takes less water if it is added in the form of one or two good applications thoroly wetting the soil, than if added a great number of times but in small amounts. Again, if applied, say mostly in July, better all around results are obtained. At times one would be justified in adding water in the fall but not as a general practice. Whenever irrigation is resorted to, it should soon be followed by thoro cultivation. In certain locations, like Rogue River and Hood River, we find just as fine fruit grown without irrigation as with it, altho certain areas doubtless would be benefitted by irrigation. The problem in these localities will be largely a financial one, whether one or two irrigations, with moderate amount of cultivation, is cheaper than very intense cultivation. In the Grand Ronde Valley young orchards up to the time of heavy bearing seem to do very well without any irrigation, but heavy bearing orchards seem to need several irrigations in order to mature a heavy crop of large apples. In the Willamette Valley cultivation is all that is needed.

There are a good many systems of irrigation in vogue. The one most commonly used is to plow ditches on each side of the rows of trees. But, whatever the system used, the aim should be to allow for as even a distribution of water as possible. In regard to the kind of water used, we find well, river, spring, and artesian water. Where the two latter are used it is a good plan to have the water analyzed to determine whether or not it contains injurious salts. One grower in southern Oregon collects the drainage water in a reservoir where it is pumped by a gasoline engine into a large tank and from that sent over the fields. The leakage from the tank is pumped by a ram to the farm buildings. Wherever land is irrigated it should be well under-drained, thus preventing the accumulation of injurious salts or acids.

Irrigation has a tendency to prolong the growing season, at times

producing a secondary growth. We have at this date, December 12th, two apple trees which still have nearly their full leafage. These were irrigated heavily, while the surrounding trees were not. These

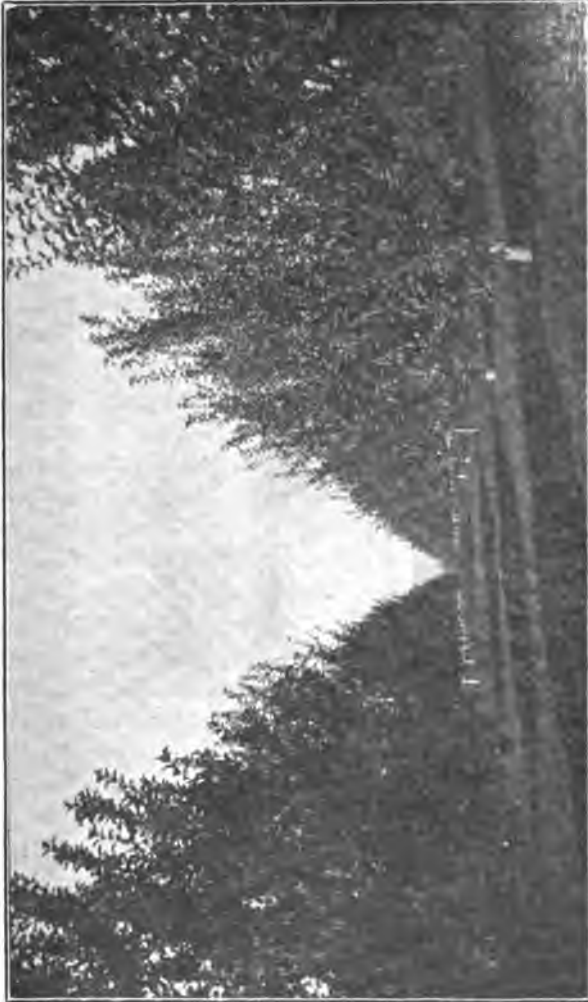


FIG. 16.—These trees have been started low and are easy to take care of. The proper height for this state. Soil mulch is ideal. Tow-headed trees and large financial returns are synonymous when given good care.

latter long ago entered the rest period. Whenever this practice of late irrigation is employed the twigs and buds do not seem to harden properly and in case of a hard freeze they are liable to be injured and the result will be a light apple crop. This very case hap-

pened the past season. It is sometimes given as an argument in favor of irrigation that in the mountainous states and in some of the states like Minnesota where the land has been heavily irrigated or where it is naturally moist and heavy; that apple trees do not suffer as much. Whereas, on dryer land, the trees are often killed. This doubtless is true. The presence of moisture in the soil tends to absorb much of the frost, while in dry soils the tree is obliged to receive it. But this has little to do with hardening buds in our climate. The very fact that the trees retain their leaves is in itself an indication of a forced soft growth and energy expended in these lines that would be better exerted in hardening wood and bud. Often where pears are irrigated it produces a very rapid soft growth and when the trees are attacked by the blight they succumb very rapidly. Especial care should be used also in irrigating the cherry and peach not to produce too rapid and soft growth. In short, you must study the action on the different fruits.

On moderate heavy loams we find we can grow apples that keep longer than on the light loams where apples naturally mature more rapidly and consequently have a shorter life. This fact has led some to conclude that the irrigated apple is a superior keeper. On the contrary, where fruit is heavily irrigated, we find that size is gained, but flavor, aroma, keeping and shipping qualities are sacrificed. Especially is this true with pears and peaches. Now, as a state, we have earned a reputation for producing fruit of quality, fruit of unrivalled flavor, of unsurpassed color and keeping and shipping qualities, and we should guard this reputation jealously.

The action of irrigation on the soil should be closely studied, from both the chemical and the physical standpoint. The nature of the soil must determine to a very large degree the methods to be employed. You must solve this problem largely to yourself. While the principles are the same, the application of them will be very different under the various conditions. If we can increase the net returns of our orchards and not sacrifice any of our reputation, then by all means irrigate; but be sure of your position.

PROPAGATION.

The propagation of the pomaceous fruits must depend upon the development of seeds, buds or scions. Subjected to circumstances favorable for growth, the bud or graft will make as

sturdy a tree as the seedling. Budding and grafting are employed in all our propagation of the better class of fruit, as this method is the only way to multiply the variety true to type. It never pays to propagate by seeds unless you are looking for a new variety or wish stocks for budding. The common and best method for securing trees is budding in late summer while the sap is still active. These buds are inserted on well formed young stocks and are far superior to the root-grafted tree. (See fig. 4).

When it is thought desirable to grow apple stocks at home, the seed should be sown in the fall in strong land that has been very deeply cultivated. Seldom ever is it profitable to bother with apple seed, as nice young trees of any variety can be obtained from any of the various nurseries in the state at a very reasonable cost.



Fig. 17.—These trees are practically out of reach and valueless. Result of close planting and poor pruning.

Many of the difficulties met with in fruit culture, as maladies of various kinds, unfruitfulness, and so forth, are induced by a careless and indiscriminating method of propagation. The stock has a most important influence on the health and longevity of the tree and should therefore be propagated and selected with due regard to its soundness, vigor and hardiness of constitution. In all propagation use only the best material. The scions should be only from the ends of bearing branches and of the last year's growth. Do not use suckers or water sprouts of any kind. (See figs 5 and 6).

Select only that which shows vigor, constitution and that which meets your requirements.

The one essential thing in budding and grafting is to bring the

cambium layer or inner bark of the stock and scion in perfect contact. The whole process is very simple, but it is best to secure the services of an experienced workman if you do not understand the process. It is best to do grafting in the spring. There are many

methods of grafting but only a few are in common use or of any practical value. (See fig. 6). Grafting is employed for top working while budding is employed for multiplying the variety. (See figs 7, 8 and 9).

TREES.

Under this head we will first take up the importance of care in selecting the stock. The nurserymen sow the apple seed in rows and when these have attained the proper size, desirable varieties are



Fig. 18.—Usually the result of the open center tree. This may be prevented by artificial wiring or inarching, but expensive and unsatisfactory. This may partly be obviated by judicious training and pruning.

worked on to the seedling stock. The best method of securing your trees is to take scions from trees of well known characteristics and habits in the vicinity in which you wish to plant and send them to the nurseryman for him to work the same on suitable stock for you. (See fig. 4).

The trees that are one year old from the bud or graft are the most desirable as they are then in a state to be properly trained. The

reasons for buying one-year old trees are this: the root system is not so badly damaged in transplanting, the tree has not grown crooked, they can be started to suit the grower and not so liable to die when transplanted as the older trees. Some nurserymen practice cutting off the tap root which makes the tree handle better and this is considered a good practice to a certain extent, but the tree needs the tap root to go deep into the soil and thereby avoid severe conditions. The root system must be judiciously formed. The tap root may be cut off to a certain degree, but cut back all the root system equally. All mangled and bruised roots must be removed, and remember where a smooth clean cut is made several new rootlets will issue. It is readily seen then that a moderate root pruning is beneficial. The top should be cut back in proportion to the roots. A yearling tree should be cut off about forty inches from the ground, and the lower limbs started from eighteen to twenty inches from the soil. A two-year old tree should have its branches cut back from one-half to one-third of their length and all cross limbs cut out. When a tree is taken out of the nursery row a large portion of its root system is left in the soil. The balance between the roots and the top is thus destroyed and pruning must be resorted to in order to reestablish the equilibrium. Nearly all of the elements which build up a tree are taken from the soil in a liquid form and carried to the leaves of the tree and worked into a suitable form for its use. This shows how important the roots are to the plant.

We find people who advocate the Stringfellow method of root pruning and planting, but there are very few places and conditions where it will be of value. In a long growing period and rich soil, the trees may adjust themselves, but who would ask better growth of an orchard when our present method of cultivation and handling are carried out properly. Trees in this state come into bearing plenty soon enough for their own good. Young trees should not be permitted to bear heavily until they're from six to eight years of age.

WHERE TO PURCHASE.—The buyer must secure his goods where the best can be obtained with honest dealing. We heartily advocate buying trees from our home nurseries; the trees are acclimated, the temperature is mild and the trees escape severe conditions. Always patronize home industry if possible. It should be remembered that nursery stock should never be purchased just because it is cheap. If possible go direct to the nursery and choose the trees for your-

self. The large sized trees are not always the most desirable, but rather choose a medium size, vigorous, straight, stocky tree of a firm, hard growth and free from disease. Crown-gall and woolly-aphis are the worst pests on young trees, also green aphis. An orchard planted with infected trees will never be of any value. The tendency is to buy trees too old rather than too young.

When the trees arrive they should be immediately unpacked and heeled in. The heeling-in process is very simple; a trench is dug deep enough to accommodate the roots nicely, and the trees are placed with their tops facing the south. The time to purchase your trees is in the fall for this climate. Assuming the time has arrived for you to buy, the next and exceedingly important subject is the kind to buy.

WHAT VARIETIES SHALL I PLANT?

There is no more important question connected with the industry and more often asked by fruit growers. The ordinary fruit grower has not time to test varieties and this should be done by our various experiment stations. It is also very difficult for an experiment station to tell what varieties will succeed best on every man's farm in the state, but the behavior of varieties on the station grounds will give sufficient knowledge to limit the varieties to certain localities.

The following list of fruits which are adapted to certain localities of the state will serve to answer "What varieties shall I plant?" and is intended to be of value to the prospective fruit grower in this state. The state is divided into five horticultural districts and each one supports a commissioner. The following is a complete list of the officers of the state board of horticulture, as well as the suitable varieties to plant; also the horticultural districts.

BOARD OF COMMISSIONERS.

State at Large and president.....	W. K. Newell, Gaston
First district	J. H. Reid, Milwaukee
Second district	Chas. A. Park, Salem
Third district	A. H. Carson, Grants Pass
Fourth district	R. H. Weber, The Dalles
Fifth district	Judd Geer, Cove
H. M. Williamson, Secretary.....	Portland

The district boundaries are as follows:

First district—Multnomah, Clackamas, Yamhill, Washington, Columbia, Clatsop and Tillamook counties.

Second district—Marion, Polk, Lincoln, Benton, Linn and Lane counties.

Third district—Douglas, Jackson, Klamath, Josephine, Coos, Curry and Lake counties.

Fourth district—Wasco, Morrow, Crook, Gilliam and Sherman counties.

Fifth district—Union, Baker, Umatilla, Wallowa, Grant, Malheur and Harney counties.

List of varieties well recommended for the several pomological districts of Oregon:

FIRST DISTRICT.

Apples—Red Astrachan, Early Harvest, Yellow Transparent, Dutchess, King, Gravenstein, Wealthy, Famuse, Spitzenburg, Yellow Newtown, Baldwin, Jonathan, Gano, Northern Spy, Red Cheek, Pippin, Winesap and Russet.

Pears—Bartlett, Bonne de Jersey, Angouleme, Fall Butter, Clairgeau, Seckel, Idaho and Winter Bartlett.

Cherries—Royal Anne, Bing, Lambert, Black Tartarian, Kentish, May Duke, Major Francis and Black Republican.

Plums—Green Gage, Reine Claude, Peach Plum, Yellow Egg, Blue Damson, Washington and Bradshaw.

Prunes—Italian, Petite, Silver and Hungarian.

Peaches—Alexander, Hale's Early, Early Crawford, Late Crawford, Salway and Elberta.

Grapes—Concord, Worden, Niagara, Moore's Early and Delaware.

Strawberries—Albany, Wilson, Clark's Seedling, Sharples, Magoon and Excelsior.

Raspberries—Cuthbert, Marlboro, Gregg and Cumberland.

Blackberries—Lawton, Taylor and Kittatinny.

Currants—Fay, Cherry and White Grape.

Gooseberries—Champion and Downing.

SECOND DISTRICT.

Apples—Yellow Transparent, Early Harvest, Red Astrachan, King, Gravenstein, Wealthy, Famuse, Dutchee, Yellow Newtown, Jonathan, Baldwin, Winesap and Babbitt.

Pears—Bartlett, Seckel, Clairgeau, Bosc, Comice, Winter Nelis and Idaho.

Cherries—Royal Anne, Lambert, Bing, May Duke, Black Republican, Black Tartarian, Waterhouse, Elton and Willamette.

Plums—Reine Claude, Willamette, Bradshaw, Peach Plum and Brignole.

Prunes—Italian, Petite, Silver, Hungarian.

Peaches—Early Crawford, Late Crawford and Foster.

Grapes—Concord, Delaware, Worden and Moore's Early.

Strawberries—Magoon, Clark's Seedling and Wilson.

Raspberries—Cuthbert and Marlboro.

Blackberries—Lawton and Kittatinny.

Currants—Cherry and Fay.

Gooseberries—Downing and others.

THIRD DISTRICT.

Apples—Gravenstein, Spitzenburg, Yellow Newtown, Jonathan.*

Pears—Partlett, Comice, Bosc, Anjou and Winter Nellis.

Cherries—Bing, Royal Anne and Black Republican.

Plums—Washington, Coe's Golden Drop and Yellow Egg.

Prunes—Italian and Petite.

Peaches—Alexander, Hale's Early, Early Crawford, Globe, Muir, Cling and Salway.

Grapes—Concord, Moore's Early, Moore's diamond, Worden and Eaton—American varieties; Tokay, Rose of Peru, Black Prince, Black Hamberg, Malago, White Muscat, Golden Queen, Thompson's Seedless.

Strawberries—Magoon, Brandywine, Haverland, Jessie, Sharpless and Marshall.

Raspberries—Cuthbert, Gregg and Mammoth Cluster.

Blackberries—Lawton, Kittatinny and Mammoth.

Currants—Cherry and Fay.

Gooseberries—Downing, Oregon Champion and Industry.

FOURTH DISTRICT.

Apples—Red Astrachan, Gravenstein, Yellow Transparent, King, Dutchess, Yellow Newtown, Baldwin, Northern Spy, Wagener, Winter Banana, Hyde-King, Red Cheek Pippin, Jonathan, Winesap.

Pears—Bartlett, Anjou, Buerre Easter, Winter Nellis, Flemish Beauty and Comice.

Cherries—Black Tartarian, Lambert, Black Republican, Royal Anne, Bing and Early Richmond.

Plums—Abundance, Prunus Simoni, Peach, Columbia, Yellow Egg.

Prunes—Hungarian, Italian, Petite, Silver and Tragedy.

Peaches—Alexander, Elberta, Foster, Weber's Prize, Crawford's Early, Crawford's Late, Lemon Cling, Early Charlotte, Hale's Early and Salway.

Grapes—Black Hamberg, Muscat, Black July, Rose of Peru, White Sweetwater, Muscatella and Tokay.

Strawberries—Clark's Seedling.

Raspberries—Cuthbert and Gregg.

Blackberries—Kittatinny, Lawton, Snyder and Mammoth.

Currants—Cherry, Fay and White Grape.

Gooseberries—Champion and Red Jacket.

FIFTH DISTRICT.

Apples—Rome Beauty, Jonathan, Gano, York Imperial, King and Spitzenburg.

* None others should be considered.

Pears—Bartlett, Clapp's Favorite, Anjou and Beurre Easter.

Cherries—Bing, Royal Anne and Lambert.

Prunes—Italian, Hungarian.

Peaches—Early Crawford, Elberta, Globe and all early varieties.

Grapes—Concord, Worden and Sweetwater.

Strawberries—Clark's Seedling, Sharpless and Magoon.

Currants—Fay.

Gooseberries—Industry.

The Spitzenburg and Newtown varieties seem to do best in the lower valleys, while such varieties as Rome Beauty, King, York Imperial and Jonathan prefer the higher altitudes. It must be thoroly understood that certain parts of our state are more adapted to growing the different kinds of fruits, and do not try to grow those that are not adapted to your locality. There is always money in producing first-class fruit, no matter whether you are raising Newtowns or Baldwins.

In the eastern part of our state, where the altitude ranges from two thousand to four thousand feet, the fall varieties of apples may be successfully grown, but the fall varieties usually mature in high altitudes about the same time as the winter varieties in lower altitudes. The season is too short to grow winter varieties very successfully, while in the lower altitudes and valleys most any variety may be grown. Assuming the above list will enable one to choose judiciously his varieties, we will next take up the subject of

PLANTING.

WHEN TO PLANT.—The fall is without question the time to plant in Oregon. There are a few objections to this in the eastern part of the state. The soil is more fit to be handled in the fall, the farmer has more time and the trees become well established before the growing season the following spring. Only once in eight or ten years will damage be done to an orchard in eastern Oregon if set in the fall.

HOW TO PLANT.—The hole should be made to accommodate the root system without cramping it and deep enough so that the roots are not liable to dry out the following summer. The hole should be dug broad and plenty of pulverized soil at the bottom to furnish food for the tender feeding rootlets.

The thing to bear in mind is to plant your trees deep and allow the tap root to go straight down into the moist rich subsoil, and the other roots to make a lateral and downward growth. The only

guide as to depth is to place them a few inches deeper than they were in the nursery. The earth should be well packed about the tree when it is planted in order to withstand the pressure of the wind. While filling up the hole see that the fine soil is neatly packed among the fibrous roots and all roots are in their proper position. Trees should be planted only when the soil is in a friable loose condition, as handling while too wet will do serious injury. If the trees are planted according to the foregoing manner and the

top cut back, there will be no need of tying or staking.

The question of setting the trees straight is solved by every orchardist having his own plan, but the topography of the land figures quite extensively in the method. If the ground is level, have sticks about one foot long and secure a strong wire as long as the orchard if possible. Mark off the distance on this line for each tree and place a peg there. Then mark each side of the orchard in this way. To fill in the square draw the line from the end peg to the other, and then another row is put out. Thus the operation is carried to the other side. After the stakes are placed properly for the trees, secure a four-inch strip about four feet long with a hole in each end large enough to allow a stake



FIG. 19.—Result of removing limbs properly. No. 1 shows how a wound may be assisted to heal. No. 2 shows a wound perfectly healed. No. 3 shows wound almost closed.

to be driven thru. Cut a notch in the middle of the stick; when you place the notch on the guide stake put a stake thru each hole on the end, and then lift the bar to allow the digging of the hole. Having the hole dug, put back on the two stakes the marking bar and place the tree in the notch, instead of the guide stake. If this work is done carefully every tree will be in its proper place (See Fig. 10).

The plan of planting is to be decided by the individual. The two

plans most used are the opposite or square (Fig. 11) and the alternate or hexagonal (Fig. 12). To set out the hexagonal, the following plan which is taken from "Barry's Fruit Garden" is thought quite simple and efficient:

"Suppose, for instance, we propose to plant a plot of ground one hundred feet square, and to have the trees twenty-five feet apart every way, we make a triangle of wood, A, B, D, (Fig. 12) each side of which is twenty-five feet; we then measure the distance from the angle, B, to the center of the opposite side, at C, and this gives us the distance between the rows, which will be about twenty-one feet. This will be called the small measure; and with this we measure off on two sides the distances for the rows, and put down a stake at each. We then commence on the first row, and with the long (twenty-five feet) measure mark off the places for the trees, and put down a stake to each. The measurements must be made with exactness, in order to have the plantation present a regular appearance, as in Fig. 12."



FIG. 20.—This kind of pruning is never permissible, always cut close to the trunk and make a smooth wound.

The hexagonal plan will accommodate more trees and all will be an equal distance apart. In this plan there is a larger clear area about each tree. Be sure to set your trees properly and a good distance from the fence. Properly set trees are much easier to take care of than those that are improperly set. The distance for plant-

ing is much disputed among horticulturists, but thirty-five to forty feet is the most desirable for apples. Never, under any conditions, plant these less than thirty feet apart. For planting table of fruits see appendix.

CARE OF TREES.

AT PLANTING TIME.—Prune the roots as soon as they are dug and immediately pack them for shipment, or, best of all, put them in their permanent place if possible, always protect them from winds, freezing temperature and strong sun. Cut all damaged and bruised

roots off at planting time, and remember always to keep them covered with a wet cloth, straw, or moss while out of the ground.



FIG 21.—The result of leaving a stub. The heart of the tree is all decayed.

PRUNING.

This is a broad subject and one that is not much understood by most people. Usually, when a man buys trees, he thinks he must be always pruning them, but such is not the case. Pruning is to assist nature and must be done with certain definite objects in view, namely, to promote growth, to produce fruit spurs, to retard excessive growth, and to form the tree in the desired shape.

There is a struggle for light, heat and air among the individual branches or twigs of a tree which is commonly termed "struggle for existence." Every twig requires air, heat and light, and as each has not the same position on the tree, some must die or be removed. Those near the centre must be watched more closely as those near the outside receive plenty of air and sun. Almost every variety of trees have their individual shape. If each is studied and pruned

according to their characteristic tendencies, the process of pruning will be very simple.

AT PLANTING TIME.—When the young trees have been root-pruned and planted, cut the top back so it will balance the root system, and, by all means, do not allow all the scaffold limbs to issue from or near the same place. A tree with limbs issuing from the same point is doomed when the fruiting period begins, and the danger increases as the tree grows older (See Figs. 14 and 15).

Some people prefer the high-headed trees, while others favor the low-head, and this is determined to a great extent by the conditions of the locality, but the ease of picking, spraying and pruning low-headed trees far outclass the disadvantage of cultivation, and for the above reasons the low-headed tree is always to be re-

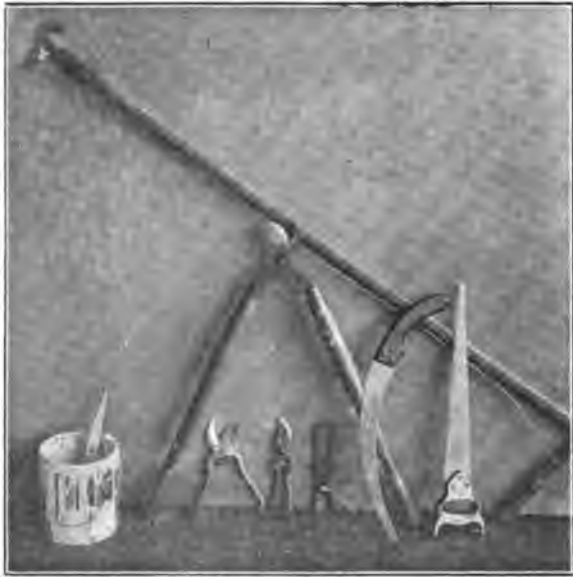


FIG. 22.—A group of satisfactory pruning tools. Every one necessary. Do not overlook the paint or wax can.

commended in this state (See Fig. 16). It is generally thought by fruit growers that the high-headed tree is better as it allows better and easier cultivation. This is the main point upon which the advocates of high-headed trees base their whole argument. A high-headed tree is generally the worst kind to cultivate under for usually the lowest limbs are permitted to make a decided lateral growth almost parallel to the soil, and when these limbs are laden with fruit they extend almost to the ground and it is readily seen that close cultivation is impossible.

The trees in the old orchards and yards all over Oregon show the evolution of the high-headed tree. It is simply this, when the



FIG. 23.—This tree has been neglected and unprofitable for years.



FIG. 24.—Same tree as shown in Fig. 23 after pruning. More than enough wood left. If pruned too severely the first year, a growth of water sprouts would be the result. It may be headed back and lightly pruned next year.

lowest limbs interfere with cultivation they are removed, the next set of limbs are permitted to make a lateral growth similar to the first, and eventually these are cut off. Thus it continues until the crown of the tree is ten to fifteen feet from the ground and the fruit is practically out of reach (See Fig. 17).

On the other hand the crown of the low-headed tree is started near the ground and the limbs make an upright slanting growth, which allows far closer cultivation. The limbs, by pruning, are caused to grow strong and able to support their fruit. As stated



FIG. 25.—The smooth twigs have been sprayed each year, while the moss-covered ones have been neglected. Lime and Sulphur sure death to moss.

before, 'the low-headed tree is much easier pruned, sprayed, picked, and the trunk protected from sun-scald. Cultivation can usually be easier done with low-headed trees than with high-headed ones, as they are usually grown. Ordinarily the trees are not kept pruned and the limbs droop, so as to hinder cultivation.

The choosing of low or high-headed trees usually determines the profit or loss to the grower. Therefore, summing up the advantages of the low-headed tree and comparing them with the advantages of

a high-headed one, it is readily seen why the latter is becoming very unpopular.

The yearling tree which is nothing larger than a good sized buggy whip, should be cut off about forty inches from the ground when planted and those buds eighteen to twenty inches from the soil should be encouraged to form the crown. All below should be removed.

ANNUAL PRUNING.—After the crown has been properly started the first year, the next great important step is to decide at the beginning of the second year whether you are going to grow trees with a



FIG. 26.—The only way to keep pace with the multitude of insects and fungi. There are now many different spraying machines on the market.

central leader or hollow centre. These methods of forming trees are much discussed by prominent orchardists thruout the state, and both methods are being used. The great advantage of both methods being used in the state is that they afford an object lesson, and hence we have but to compare results (See Fig. 18). The object of cutting out the centre of a tree is to give more light, more circulation of air and better color to the fruit. By this method, the life of the orchard is sacrificed for the above conditions, as the trees trained this way break down when they begin to bear, or neccessitate continual wiring of the scaffold limbs. All of this is of course unnatural and expensive and can be overcome by proper pruning and permitting the central leader to remain.

When the leader is permitted to make a strong upright growth,

it acts as a balance to the whole tree and does away with inarching, wiring, and with judicious pruning the trees do not need propping. Generally the open centre tree is denser in the centre than the other for the scaffold limbs are pulled too close together.

Interlacing, crossing, rubbing and diseased branches must always be removed, no matter what the ideal form of the tree may be. If your trees are making too much wood growth, cut them back in the summer, which will cause them to produce fruit spurs and make a



FIG. 27.—A fair sized tree cut back for top-working. Be sure to leave some of the top to carry off the surplus sap.

stronger growth, but do not cut back too far as the fruit is liable to sun-scald, and if pruned too severely the tree will make a heavy sucker growth. It is best to prune moderately in winter for excessive and undesirable growth, and prune moderately the following summer, about July, to check the wood growth. If the trees are making a poor wood growth and more wood is desired in preference to the fruit, prune in the winter. This must be done in moderation to avoid a heavy sucker growth the following summer. It is always best to prune moderately every year both in winter and summer if

necessary. Pruning may be done in Oregon anytime while the trees are dormant, except where severe freezes are frequent.

In pruning the tree fruits, always make a clean smooth cut and have a bucket of good wax or paint handy and thoroly cover the wound. This prevents decay of the wood and allows the new tissue to grow over unmolested by fungi or the elements. The cambium or inner bark will begin to cover the wound as soon as the tree becomes active in the spring, but will form only over a limited portion of the cut surface. The growth of the cambium can be encouraged and made to completely cover the wound if cut along the inner side of the callus with a sharp knife. In all your pruning take the branch off just as close as possible to the limb where it issues and never leave a stub. (See Figs. 19, 20, 21, 22, 23 and 24.)

SPRAYING.

This subject is becoming of greatest importance, as our orchards show, if we stop to examine them. Spraying is only one of the requisites to success in up-to-date fruit growing. It must be understood that

spraying cannot take the place of cultivation and is only an insurance to the grower. Trees grow by assimilating plant food and if scale and other diseases are at work the trees do not develop and the fruit is not allowed to go on the market. There are five essential operations upon which success in fruit raising depends. They may be given as follows: Tillage, fertilizing, pruning, spraying and thinning.

Spraying is becoming so thoroughly understood that most of the diseases can be held in check or entirely eradicated. Spraying



FIG. 28.—Young top worked tree. The scions have grown rapidly and a well balanced tree is the result. This tree will need judicious pruning and care for several years. Photo taken year and half after grafting.

should be done every year to guard against any disease that the tree may become affected with, or to destroy what may be already established, and destroy those pest that are injurious to the fruit. Years ago horticulturists did not understand much about fruit diseases and the effects of spraying but the problems are being very rapidly solved (See Fig. 25). The kind of machine and apparatus to use depends upon the notion of the fruit grower. However, the pump should be strong and well fitted with hard brass working parts. The nozzle must be chosen in regard to its power to carry and deliver the material properly. There are now many different kinds of spray outfits, but the ones that are desirable are those that meet the above requirements and can be well operated under the existing conditions where they are to be used. (Fig. 26) When you spray, do it at the proper time and do it well. If you do not, it is a waste of time and material. The material must be properly mixed according to formulas given in the best spraying bulletins. For further knowledge of the pests and diseases and how to combat them, the reader is referred to bulletins on spraying by Prof. A. B. Cordley of this station. Also see appendix.

THINNING.

Thinning the fruit is a practice always advised and is exceedingly profitable. Some people think it does not pay but there is hardly today a successful fruit grower in the state who does not thin his fruit, and this thinning is the key to his success over those who have favorable conditions, but do not put out the firstclass product. The fancy fruit and price is obtained by proper thinning. It makes the fruit larger, better color, reserves the vitality of the tree, destroys disease infested and imperfect specimens, and tends to cause the tree to produce an annual crop.

All the fruit must be picked sooner or later and many more apples will be worth picking if encouraged by thinning. An orchardist in southern Oregon thinned his apples this year to one on a spur and the result was that ninety percent of the entire crop sold in the three and one-half tier class. Determine then for yourself if it pays.

Always thin to one fruit on a spur and where the spurs are close all the fruit should be removed on a few of the spurs. The best apple of the cluster is the one to leave. The earlier the thinning the better, as the remaining fruit receives all the energy from the very first of its growth. The thinning should be done when the fruit is about the size of a hazelnut. It sometimes requires more

judgment and discrimination to thin fruit properly than it does to gather it. The cost of thinning depends upon the price of labor, and the condition of the trees. Usually the price will range from fifteen to eighty cents per tree.

Do not let your trees bear heavily while young as every fruit they produce reduces their vitality and heavy yields ruins the form of the tree. There is plenty of time for trees to bear after they have received the proper training and preparation for future usefulness. Some men boast of the wonderful yield of their two and three year old apple trees, but they do not realize what that means to them in the future.

POLLINATION.

There is no greater need of study of any one phase of pomology more than pollination. The present knowledge among horticulturists of this subject is quite limited, but we are rapidly securing more valuable facts along this line.

It is not safe to plant an orchard without knowing whether the varieties are self-fertile or self-sterile, and their ability to cross-fertilize with other varieties. Not all failure to set fruit is due to imperfect fertilization. The efficiency of pollen varies with the conditions of the tree and environment. Some of the main factors which govern pollination are vigor, variety, health, age, heredity and vitality of the tree. Most all varieties are improved by cross-fertilization, and a large orchard should be planted with one-third of the trees as pollen producers.

It is known that the same varieties do not blossom at the same time in different parts of the state, but like conditions will affect the same varieties alike. Varieties that are useful for producing pollen must blossom at the same time the desired varieties blossom and the pollen must be potent on that variety. Up to the present time all the work in pollination has shown the following varieties are more or less self-sterile and should not be planted alone: Northern Spy, Gravenstein, Grimes, Tompkin's King, Red Astrachan, Esopus Spitzenburg, York Imperial, Belleflower, Winesap and Willow Twig. The varieties that are found to be self fertile are: Rome Beauty, Jonathan, Ben Davis, Oldenburg, R. I. Greening, Fallawater, Baldwin and Yellow Transparent.

The pear varieties considered self-sterile are: Anjou, Bartlett, Bosc, Clairgeau, Clapp, Columbia, Gray Doyenne, Easter, Howell, Idaho, Jones' Seedling, Kieffer, Lawrence, Louise, Mt. Vernon,

Pound, Sheldon, Superfine and Winter Nelis. Those considered self-fertile are: Buffum, Angouleme, Elizabeth, Flemish, Le Conte, Seckel, Tyson and White Doyenne.

"Some of the combinations that have been successful in many parts of the country for planting together are: Bartlett with Nelis, Flemish Beauty, Easter, White Doyenne; Idaho with Bartlett; Kieffer with Le Conte, Garber; Coe Golden Drop with French Prune, Green Gage, Italian Prune; Satsuma with Abundance, Burbank, Red June; Miner with De Soto, Forest Rose, Wildgoose; Wildgoose with De Soto, Newman, Miner."—How to make a Fruit Garden.

There are two main factors in selecting varieties for cross-pollination. The first requisite is that there must exist a mutual affinity between the two; the second, they must blossom about the same time.

The 1905 report of the State Board of Horticulture contains a very valuable chart on the blossoming of varieties. The chart, which is completed by Prof. E. R. Lake of this station may also be found in his Bulletin No. 82.

RENOVATING NEGLECTED ORCHARDS.

In almost any part of our state can be found orchards of advanced age which do not pay, and it is readily seen that something is wrong. The problem of renovating an orchard is sometimes a large one and often proves to be very expensive. The causes which are responsible for an unprofitable orchard are many and may be briefly stated thus: Unsuitable varieties, poor drainage, unfavorable site, poor soil, neglect, unfavorable climatic conditions and old age.

The first and most important point in rejuvenating an orchard is whether or not the trees are worth saving. The varieties may be not what you desire or too far gone to be responsive to treatment. If the trees are on wet land, cut them down or thoroly drain the soil, as a fruit tree will never thrive with wet feet. Apple trees over thirty-six or seven years old, which have long been neglected, are not worth saving; likewise the cherries over twenty, the pear over twenty-two or three, the plum over fifteen and the peach over twelve years of age. In fact, the trees which should not be worked with are those with a high head, partially decayed trunk and in a generally run-down condition. If nothing more serious than insects and fungus diseases are present, the orchard may be very eco-

nominically reclaimed, as, for example, the Eisman Brothers' orchard, which was saved from anthracnose by Prof. A. B. Cordley of this station.

The renovating of old trees requires practically the same treatment and methods as to properly care for the young orchard. The trees must have a general awakening and started into growth both in fruit and wood. They should make new twigs twelve or more inches long each year instead of the usual one inch growth. The first thing to be done then is to break up the sod and get the soil into cultivation and feed the trees by applying barnyard manure, wood ashes and any nitrate or phosphorus fertilizer. Especially add nitrogenous cover crops. This is essential for stimulating a good growth of the trees.

See that all surplus water is carried away and then begin war on the large army of insects and numerous diseases that have been at work for years. Buy a good spray outfit with plenty of material to spray with, and learn thoroly how and when to use them. Spraying calendars as well as information on diseases and insects may be had by applying to the station director for bulletins on the subject. Every other tree will probably have to be removed, as most of the older orchards were planted too close. Make a thoro study of your orchard before cutting out any trees and arrange if possible to cut out those that cannot be saved by the most skillful treatment.

Next comes the management of the individual tree. The chances are that the tree presents a hard appearance. In this climate the moss and lichens soon cover the bark and water sprouts become numerous. Various fungi and insects thrive unusually well here and at the expiration of twenty years or more the uncared-for orchard is quite a study. The first thing to do with the tree is to prune it properly if it is not to be top-worked. Do not prune the tree too severely the first year, as it will produce suckers and water sprouts in large numbers, but keep after it systematically each year until the tree is well thinned and properly balanced. (See fig. 24). If you do not wish to keep the original varieties, the trees may be top-worked or grafted. It is not advisable to graft trees that are too old, as usually their vitality is low, and better fruit can be obtained sooner from newly planted trees. (See figs 27, 28).

Do not graft limbs that are over three or four inches in diameter as young wood unites better and makes superior growth. It is

best to graft the smaller limbs of the tree in such a manner as to form a well balanced head and leave plenty of the original top to carry off the surplus energy until the grafts require the room, which is about the second year. Cleft-grafting is the best method for working over large trees. A top-grafted tree will usually come into bearing in three to six years. The old adage, "An ounce of prevention is better than a pound of cure," is quite true in regard to growing fruit trees.

APPENDIX I.

HORTICULTURAL SOCIETIES AND UNIONS IN OREGON.

1. Oregon State Horticultural Society—E. R. Lake, Secretary, Corvallis.
2. Forest Grove Horticultural Society, Forest Grove—Col. Harry Haynes, Secretary.
3. Clackamas Horticultural Society—J. C. Zinzer, Secretary, Oregon City.
4. Mosier Horticultural Society—A. P. Bateham, Secretary, Mosier.
5. Medford Horticultural Society—L. B. Brown, Secretary, Medford.
6. Medford Fruit Growers' Union, Medford.
7. Ashland Fruit and Produce Association.
8. Hood River Horticultural Society—J. L. Carter, Secretary, Hood River.
9. Marion County Horticultural Society—E. C. Armstrong, Secretary, Jefferson.
10. Linn County Horticultural Society—F. M. Mitchell, Secretary, Albany.
11. Polk County Horticultural Society—R. L. Chapman, Secretary, Dallas.
12. Grants Pass Fruit Growers' Union—Chas. Meserve, Secretary, Grants Pass.
13. Hood River Fruit Growers' Union—E. H. Shepard, Secretary and Manager, Hood River.
14. Hood River Apple Growers' Union—E. H. Shepard, Manager, Hood River.
15. Grande Ronde Valley Fruit Growers' Union—E. Z. Carbine, Secretary, La Grande.
16. Yamhill County Horticultural Association—W. H. Kingery, Secretary, McMinnville.

APPENDIX II.

The following nurseries are doing business in this state and are submitted to the public, not to advertise the nurseries, but for the enlightenment of those interested in fruit culture. While we do not recommend any one of these in particular, the public is earnestly advised to patronize our home nurseries:

The Dalles Nurseries	The Dalles	Monte Vista Nurseries	Scappoose
Pacific Nursery Co.	Tangent	J. B. Pilkington, Nurseryman	
The Woodburn Nurseries ..	Woodburn	 P. O. box 825, Portland	
The Sibson Rose Nurseries		Thos. Prince (walnuts only) - Dundee	
..... 1180 Milwaukie Ave.		Quaker Nurseries	Salem
True to Name Nursery	Hood River	E. P. Smith	Gresham
Milwaukie Nurseries	Milwaukie	Brooks & Sons	Carlton
Albany Nurseries	Albany	Mt. Tabor Nurseries	Mt. Tabor
Oregon Nursery Co.	Salem		

APPENDIX III.

LIST OF RELIABLE WORKS ON HORTICULTURE.

The Principles of Fruit Growing	Bailey
The Principles of Vegetable Gardening	Bailey
Plant Breeding	Bailey
The Horticulturist's Rule Book	Bailey
The Pruning Book	Bailey
The Nursery Book	Bailey
Cyclopedia of Horticulture	Bailey
Barry's Fruit Garden	Barry
Bush Fruits	Card
Irrigation Farming	Wilcox
How to Make a Fruit Garden	Fletcher
American Fruit Culturist	Thomas
Strawberry Culturist	Fuller
Nut Culturist	Fuller
Spraying of Plants	Lodeman
Irrigation and Drainage	King
The Soil	King
Fertility of the Land	Roberts
Hedges and Wind-breaks	Powell
Insects Injurious to Fruits	Saunders
Fungi and Fungicides	Weed
Insects and Insecticides	Weed
Plums and Plum Culture	Waugh
American Horticultural Manual (2 vols)	Budd and Hansen
Successful Fruit Culture	Maynard
California Fruits	Wickson
Better Fruit	Hood River

Oregon Agriculturist and Rural Northwest.....	Portland
Northwest Horticulturist.....	Seattle
Pacific Homestead.....	Salem
Orchard and Farm.....	San Francisco
Western Fruit Grower.....	St. Joseph, Mo.
The Strawberry.....	Three Rivers, Mich.
Rural New Yorker.....	New York
Canadian Horticulturist.....	Toronto, Canada
Country Life in America.....	Doubleday, Page & Co., New York
Garden Magazine.....	Doubleday, Page & Co., New York
Suburban Life.....	Boston

APPENDIX IV.

FOOD POISONS—ARSENATE OF LEAD.

Arsenate of soda.....	4 ounces
Acetate of lead.....	11 ounces
Water.....	15 to 20 gallons

Dissolve the arsenate of soda in two quarts and the acetate of lead in four quarts of warm water; when dissolved add them to the required amount of water.

This formula is valuable for spraying very delicate foliage and is among the best, if not the best, of the remedies for the codling moth.

CONTACT INSECTICIDES.

Lime, Sulphur and Salt—Oregon Formula.

Quicklime.....	50 pounds
Sulphur.....	50 pounds
Water.....	150 gallons

Slake the lime thoroly, add the sulphur, cover with water, and boil briskly for at least an hour, until the mixture is of a deep blood red color with but little free sulphur on the surface. Add water to make 150 gallons.

This wash is the most satisfactory for San Jose scale and also a good fungicide.

FUNGICIDES.

Bordeaux Mixture for Dormant Plants—Bordeaux for Winter use.

Copper sulphate.....	6 pounds
Quicklime.....	6 pounds
Water.....	50 gallons

This formula should be used only upon dormant trees.

Bordeaux Mixture when the trees are in leaf.

Copper sulphate.....	4 pounds
Quicklime.....	6 pounds
Water.....	50 gallons

Dissolve the copper sulphate in water in a wooden vessel. Slack the lime, using only sufficient water to insure slacking. Add water and stir until the "milk of lime" of the consistency of cream. Strain the lime thru a sieve to remove the larger particles. Dilute the milk of lime and the copper sulphate solution each to 25 gallons and pour these solutions together.

To see if the Bordeaux mixture is made properly, test it in the following manner: pour some of the Bordeaux into a small dish and add a few drops of the ferrocyanide solution. If enough lime has been used no change will be noticed; if a brownish-red discoloration takes place, more lime should be added.

The lime, sulphur wash may be used any time while the trees are dormant. The same may be said of the winter formula for the Bordeaux mixture.

Opinions vary in regard to the application of the lead arsenate for the codling moth, but it is safe to say that the first application should be made when the petals begin to fall, other applications will vary with season and development of the moth.

GRAFTING WAX FORMULA.

- | | |
|----------------------|----------------------|
| 1. Four pounds resin | 2. Four pounds resin |
| Two pounds beeswax | One pound beeswax |
| One pound tallow | One pound tallow |

The horticultural law may be obtained by writing to the State Secretary.

LIST OF BULLETINS

(In print) published by the Oregon Agricultural Experiment Station to February, 1907.

No. 6, 1890—Chemistry, Zoölogy	Washburn
No. 10, 1891—Entomology	Washburn
No. 23, 1894—Pig Feeding, continued	French
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Department of Horticulture.



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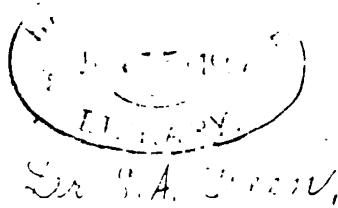
CORVALLIS, OREGON.

THE APPLE FROM ORCHARD TO MARKET

By C. I. LEWIS.

**THE BULLETINS OF THIS STATION ARE SENT FREE TO ALL RESIDENTS
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INTRODUCTION.

ALL over our state we are realizing an awakening along horticultural lines, and more especially in fruit growing. Many questions are being asked in regard to the various problems concerned with growing and packing fruit, and the formation of associations. This clamor for information is doubtless due to a number of causes—prominent among them the valiant efforts of our leading horticulturists and station workers—and the realization of fancy prices with the accompanying increase in land value. Whatever the cause, we are just beginning to realize what wonderful opportunities are at hand if we will only grasp them.

It is taken for granted that we must grow a good article. The problems connected with this phase of fruit culture are not dwelt on here. But, it is one thing to grow a fancy product and an entirely different one to dispose of the same. Yet the easiest and largest profits in any business are those made by handling a strictly first class product put up in first class condition. For the expenditure of a few cents one may often realize an increase in price of from fifty to two hundred per cent. Again, no matter what the conditions and the market may be, this kind of fruit will always be the most in demand. The question is sometimes asked, What will become of the prices when we all handle a first class product? The answer is easy: We never shall. Human nature does not seem to be constructed that way. Work as hard as we may for that end, many will still keep on in the old way. But, with a very large percentage of our growers handling their product more carefully we can and always will realize a very fair profit, making fruit growing one of the most lucrative occupations, and at the same time placing the fruit within reach of the great mass of people.

To help the growers who are desirous of putting a better pack on the market is the province of this bulletin. Thanks are due to many of our progressive growers, and more especially those of Hood River, who have shown me every courtesy and gladly given freely of their valuable experience. To the managers of the Hood River Apple Growers' Union I extend thanks for kindly suggestions as to matters concerning organization. And lastly, the publishers of "Better Fruit" have kindly loaned me certain cuts, namely, figures 1, 2, 12, 17 and 24.

PICKING.

TIME TO PICK.—No set rule can be given for the time to pick apples as that will vary according to variety, season, distance to be shipped, etc. As a rule, we gauge the time to pick red apples by



Fig. 1—A Light Ladder.

their color, and yellow apples by the darkening of their seeds. Some varieties, for instance Northern Spy, are generally left quite late in the season before picking. On the other hand, great care must be taken with Jonathans to pick them before they get overripe, or there is danger from core rot. Red Astrachans if left on the tree tend to crack. And so on. The early apples, as a rule, especially those to be sent any distance, are harvested before they are thoroughly ripe. This practice is even sometimes adhered to with fall and winter varieties and especially if they are to be shipped long distances and to cold countries such as Siberia, as they must be shipped early to avoid severe weather which would injure the fruit. Apples like Spitzenberg should be picked as soon as they have the proper color. This means, in ordinary cases, several pickings to

a tree; but only in this way can you get the best results. Every day the fruit is left on the tree after it has assumed its color, it approaches just so much nearer its final maturity and deteriorates to a marked degree in its shipping and keeping qualities. Then again, when the tree is relieved of part of its load it gives the remaining

fruit a better chance to become large and well colored. The apple does not go into abrupt stages of its life history from the green apple to the natural broken-down specimen. The change is a gradual one. The most vital point in the whole life history is the picking time.

How to Pick.—The methods employed at this time have much to do with the keeping qualities of the apple. To get the best returns, we must handle the apples as tho they were eggs, and use every precaution not to bruise and more especially not to cut the skin of the apple so as to expose it to the germs of the decays that will surely enter through any abrasion in the skin. Recent work in the Department at Washington has shown that the blue molds and other decays start in these specimens, spreading finally to the other fruit. The apple should be picked by a twist of the wrist, giving either a slight upward or downward motion at the same time. If picked this way, few or no stems will be pulled out. In fact, if the apple does not come readily when this is tried, it is a pretty



Fig. 2—Zaun Extension Ladder.

good indication that the fruit is not ready to be picked. This twisting motion prevents, to a large degree, the breaking off of fruit spurs. The best days for gathering fruit are the cool dry days. Picking during excessive heat, or exposing the fruit to heavy rains, are not conducive to good handling. Where the fruit is picked on a cool dry day it is better to get it under cover at once; but when occasion demands that we pick the fruit in warm weather, it will be better to leave it out of doors over night, allowing the fruit to become cool before taking it under cover, using every precaution to prevent heavy sweating of the fruit. The days of piling the fruit

in the orchard in great heaps or of leaving it even in boxes or barrels for several days are gone forever and cannot be resorted to by those who care to handle choice fruit.

LADDERS.—As regards ladders, one has a great variety to choose from. A man who is handy with tools can easily make his own ladders; but to the grower who is rushed it will be much cheaper to buy. It should be the policy as much as possible not to allow pickers to climb into the trees or to use heavy ladders that tend to knock off fruit spurs. Figure 1 shows a ladder that has a good deal of merit. This ladder is patented by A. A. Smith of Paonia, Col., but there are agents in different parts of our state. Its simplicity and lightness appeal to one at once, it being strong enough



Fig. 3—Ladders used by A. I. Mason.

to hold up anybody who is able to climb a ladder and yet light enough to be handled by any child who can pick fruit. It can be used in and around the branches without knocking off spurs. Figure 2 shows a ladder known as the Zaun ladder, manufactured in Portland. It is a light but durable step-ladder and has the advantage that the back can be turned up so as to form a straight line with the stile part and the wooden rod running through the center of the standard can be used as an additional extension of five feet. These ladders are simply shown as types and not necessarily as any

advertisement of these individuals. Figure 3 shows a group of ladders. One of the most useful of this group is the double tripod ladder. Each tripod consists of three light ladders hinged to a common support. A plank can be thrown across connecting the two tripods, thus enabling the pickers to gather the fruit in the center of the tree without breaking off limbs and spurs. Figure 6 shows this ladder in service.



Fig. 4—Mason table and pails.

UTENSILS TO PICK IN.—As regards utensils to pick in there is much difference of opinion. Some prefer bags, some baskets, while others prefer pails. I prefer pails, and under no conditions would use bags. During my observations this fall in the harvesting period I found that the best picking was being done by men who used pails. A good model to use is such a pail as is shown in Figure 4, used by Mr. Mason of Hood River. Other pails very similar to this



Fig. 5—The first group of pickers.

are used by other growers. These pails should be made 10x10, and will just fit into an ordinary orchard box so that to empty a pail

you place one hand over the top of the apples, lay the pail on its side in the box, and slowly lift up the bottom of the pail. Practically no bruising is done under this system. These pails should have hooks. If made with the dimensions given there is no temptation to drop the fruit into the pails; there is not the least danger of bruising against ladders; the hooks allow the pails to be hung on ladders or branches, relieving the pickers of the constant weight that the bag system demands he must carry; and they can be quickly emptied of fruit without bruising. The objections to the bags are that the bottomless bags are generally too deep and there is usually too much temptation to let the fruit shoot out, and also more or less bruising in going up and down ladders. The apron bags afford too much opportunity to bruise the fruit in going up and down ladders. If deep enough to hold a fair basketful there is a tendency to drop the fruit into them; and they also make a constant weight that adds unnecessary fatigue to the work of fruit gathering. They are awkward and slow to empty properly.



Fig. 6.—The second group of pickers.

SYSTEM IN GATHERING FRUIT.—It will sometimes be advisable to have some system in gathering your fruit. The gang of pickers might be divided into three groups, in much the same way that Mr. A. I. Mason of Hood River practices. The older and heavier persons are in the first group. They pick all fruit within reach from the ground, as shown in Figure 5. The little tables that they use are very handy, being made about the size of the boxes but having little handles protruding so that one can pick up table and box at the same time and move them around the tree. This has an

advantage in that it practically saves one handling of the apples. The second group, as shown in Figure 6, generally consists of girls and young women, who can use light ladders. The third group, shown in Figure 7, pick the remaining fruit, using the heavier ladders and doing the most reaching.

ORCHARD BOXES.—It is well to have regular orchard boxes in which to take the fruit to the storage house. Some growers use the regular packing boxes but this should not be done as it is almost

impossible to keep the boxes from becoming soiled. Orchard boxes should be made slightly larger than regular packing boxes, with cleats nailed on the ends so that they can be stacked without crushing the top fruit.



Fig. 7—The third group of pickers.

VEHICLES.—Many different kinds of vehicles are used for taking fruit from orchard to packing house. The best that I have seen is such a wagon as Mr. E. H. Shepard of Hood River uses for carrying in his fruit, (Figure 8) a low truck wagon. It rides smoothly and is so low that it avoids heavy lifting, and unnecessary shaking of the fruit.

WIPING AND TEMPORARY STORAGE.

SHALL WE WIPE?—The question often comes up,—Does it pay to wipe? It certainly does if the market demands it and is willing to pay for it. The objection is sometimes raised that the keeping qualities of fruit that has been wiped are impaired, and this may be true; but such apples are generally disposed of in the fall, and in the long run we have no figures to show definitely the effect of wiping. Nevertheless, where apples are sprayed late so that they

are spotted with spray mixture when picked, this should be removed in some way and wiping seems to be the best solution. This does not necessarily mean a great amount of polishing. Loose mits can be made easily from flannel cloth and one good twist will remove outside dust and spray spots.

GRADING BOARDS.—Some of the growers in Hood River this year have been using the grading board shown in Figure 9. A common board or piece of paste-board is hung up before the wiper. In this board holes are cut the sizes of the various tiers, such as three,



Fig. 8—Orchard wagon used by E. H. Shepard.

three and one-half, and four tier, etc. As the apples are wiped they are properly sized. The average wiper will be obliged to use this board only for the first half day, soon learning to size the apples. The advantage of this method is that the packers have the apples practically graded and can do much more work in a day, and after the first half day the wipers can usually accomplish fully as much as with the old method.



Fig. 9—Grading board.

STORING BEFORE PACKING.—Where apples are to be wiped this must be done shortly after they are picked, for if left very long they tend to sweat a trifle, and become gummy, making wiping a difficult and costly process. The apples should be stored until packed, and packed in some cool, well ventilated building. The natural moisture conditions in our climate in the fall are such that if the apples are stored where it is cool their keeping qualities do not deteriorate. Houses that can be well opened at night and closed in the daytime will furnish the best conditions as regards temperature. Never heap the fruit in immense piles or store in bins, as such methods invite sweating, and bruising in handling; but preferably use field boxes, having end cleats so that they can

be piled one on top of the other and still allow for plenty of ventilation.

PACKING HOUSES.

NECESSITY FOR.—A well built and well equipped packing-house should be found with every orchard. Unfortunately we have very few good houses in the state. Open sheds, old barns, and various other buildings, are used as makeshifts. This is not due to negligence nor to a lack of interest, but largely to the fact that many of our growers started in with little or no capital and have had to pay for their land, build homes, buy tools, horses, etc. But a large majority of them are rapidly getting to the point where they can



Fig. 10—Packing house owned at "Beulah Land".

afford to put up good packing houses. In fact, if a man has the means, he cannot well afford not to do this, as better packing can be done in a well constructed house, and generally more of it.

REQUISITES OF A GOOD PACKING HOUSE.—One of the best packing houses I have seen in the state is that shown in Figure 10, in use in the Beulah Land orchards of Hood River. The great advantage of this house over most others is that it has plenty of light and enables the packers to do good work. On cold raw days such a house will keep the packers comfortable. The open sheds will not, and most of the barns are too dark. Some builders make the mistake of making the packing house too large and thereby they lose a lot of labor in handling boxes and materials. The packing house

should be just large enough to work in comfortably, with the least possible waste room. It should have adjoining it a room where fruit can be stored to be packed, and also some sort of storage room where it can be kept in a cool temperature until shipment. Those growers living a long distance from the railroad may find it an ad-

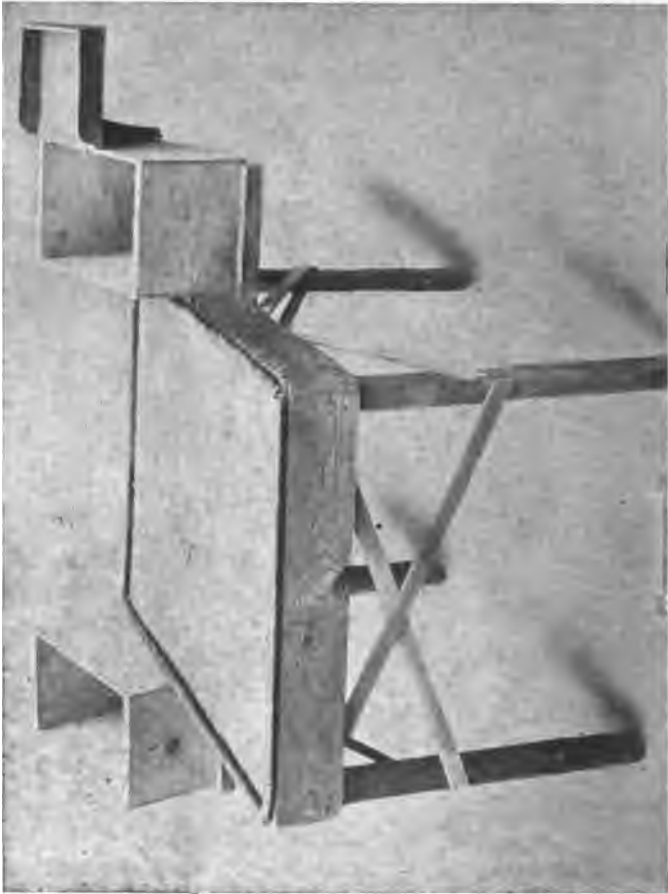


Fig. 11—Table in general use at Hood River.

vantage to have their packing houses located in the town or near the railroad rather than to try to transport the packed fruit over rough and muddy roads. To get best results in thus hauling packed fruit, it must be handled with great care and kept protected from mud and rain by means of canvas.

PACKING TABLES.—In some regions of the state packing is done from benches that are built up beneath the windows, but I believe,



Fig. 12—Packing table used by Davidson Fruit Co.

all things considered, that better packing can be done from tables, as they give the packer more fruit to choose from and allow him to

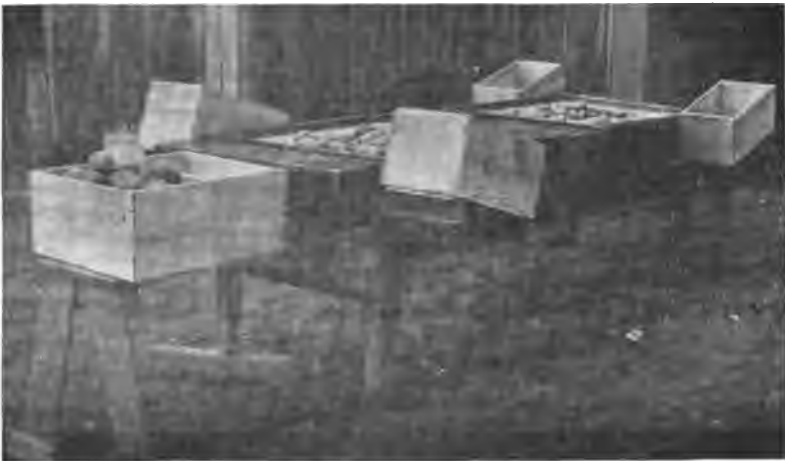


Fig. 13—Packing table for four pickers used by A. I. Mason.

do better grading. At Hood River tables are generally used. Figure 11 shows the common type used there. This table is made to

accommodate two packers. To make such a table, take four standards about three feet high. The top, made of strong burlap about three by four feet, is allowed to hang rather loosely. Therefore, saw off the tops of the legs on a bevel so as not to have the sharp corners push into the burlap, making points that will bruise or cut the fruit. Old hose pipe is generally nailed around the top of the table to protect the fruit. Besides the braces shown in the picture it is also well to wire the legs and braces together firmly as there is a heavy load to support.

The height of table suggested above is only relative, the point be-



Fig. 14—A packing scene at Hood River.

ing so to construct it as to allow a packer to work with the greatest comfort, avoiding back-bending in all cases. Three feet is generally found to be about right. The surface area of the table should not be greater than three by four feet, as anything larger would not allow two packers to reach all points of it without unnecessary stretching.

In using this table care should be taken to clear off all fruit at least eight or ten times a day; otherwise much fruit will receive hard handling by being continually "pawed over".

Figure 12 shows a table that was used by the Davidson Packing Company this year and which has the advantage that each packer has the privilege of changing hands, packing from either left or right. This table is about forty inches square but it would be better to have the sides on which the packers work a little wider, say forty-four or forty-eight inches, especially where there are rests for two boxes on each side.

Figure 13 shows a table for four packers, owned by Mr. A. I. Mason, Hood River. The horse drawn out on the side is to hold the apples



Fig. 15—A press offered to the trade.

for the wiper or grader, but by using the grading board one can dispense with this part of the table.

NAILING PRESS.—One of the most important tools is the nailing press. It is hard to imagine why some packers will still cling to the old one-armed press, when, for the expense of about six dollars, they could make a press that would do twice the work and do it better.

Figure 15 shows a commercial press which is being sold and if it could be improved somewhat it might be of good service; but at

present the clamps are not arranged so as to hold on the cleats while they are being nailed and there is no ratchet at the bottom to hold the lever in case you have misplaced your hammer. In such a predicament you have your work all to do over again.

Figure 16 shows a press in very general use in Hood River.



Fig. 16—Press in common use at Hood River.

When the box is put into position, the first pressure on the lever throws the arms forward, adjusting the cover and holding the cleats in position to nail. Further pressure brings the cover down tight where it can be easily nailed. The leverage is brought about by a rope pulley which extends from the lever vertically and then divides,

one half going to each arm. Anyone handy with tools can easily construct such a press for about six dollars and with care it will last for several seasons. The pulleys will tend to wear out and the springs that release the arms will weaken; but these can be renewed from time to time. This press could be improved if some shelves were constructed on the back similar to or a little larger than those in Figure 17, which would make room for cover strips, cleats, and nails.

Figure 17 shows a press made by Mr. Mason of Hood River. It is more durable than that shown in Figure 16 but costs about ten dollars. Instead of the rope pulleys this press has solid iron rods



Fig. 17—The press used by A. I. Mason.

connecting each arm with the lower cross-piece, to which the lever is fastened. The same bolt also brings the upper cross-piece in connection with the lever. When pressure is exerted on the lever the arms are thrown toward the box, placing the strips true and holding the cleats in place. Further pressure brings the cover down tight. The advantage of this press is its durability. In both the presses the joints of the parts which clasp the box should be crazy as rigid joints would not work as well.

These presses are simply shown to give ideas and not to act as models. With a little ingenuity one can easily construct a press

which will do good work. Be sure it is so constructed that the covers are adjusted and the cleats held in place by one operation.

PACKING BOXES.—Before the packing season commences one should see to it that he has a goodly amount of supplies on hand. The first thing to procure is the boxes. The cleaner the lumber the better. Spruce makes the best boxes. These can be bought all ready to nail up and a man can easily make his own box machine by which a boy can turn out several hundred boxes a day. A good supply of nails is needed, of which the barbed, or else cement coated, are the best. It will take at least three of these, and better, four,



Fig. 18—Attractive lithographs for boxes.

for each end. A good supply of cleats should be secured, as both bottom and top should be cleated to prevent splitting. The cleats themselves often give a good deal of trouble from splitting and most packers soak them in hot water for several hours in order to avoid this. The cost of boxes, of course, will vary according to conditions. Prevailing market prices, number ordered, and a cornered market, will all play their part. This year the prices vary from about seven cents to fourteen cents. Do not think that cheaper boxes are the best; in fact, they are the most expensive, as the material may be so poor as not to hold together well and may be of such low grade

as to cheapen the appearance of the package. Unfortunately we have not uniformity in sizes of boxes. But the Northwest Fruit Growers' Association, by their recommendations, were able to limit

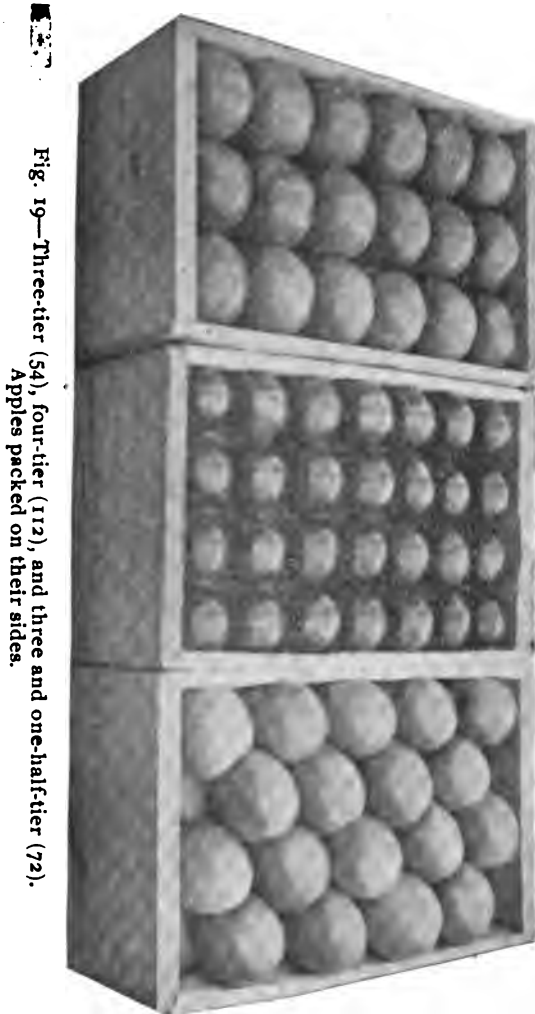


Fig. 19—Three-tier (34), four-tier (112), and three and one-half-tier (72).
Apples packed on their sides.

the number of sizes to two. Most of our fruit is packed in what is known as the standard box, which measures in inches $10\frac{1}{2} \times 11\frac{1}{2} \times 18$; but to accommodate certain apples it is sometimes found that a special box is needed which is longer and a trifle narrower, being

10x11x20. Remember that these are all inside measurements. It sometimes happens that boxes are made with these dimensions as outside measurements and it may not be an indication that the grower intends to swindle; but it looks bad. Again, you should always measure your box material before accepting it to be sure

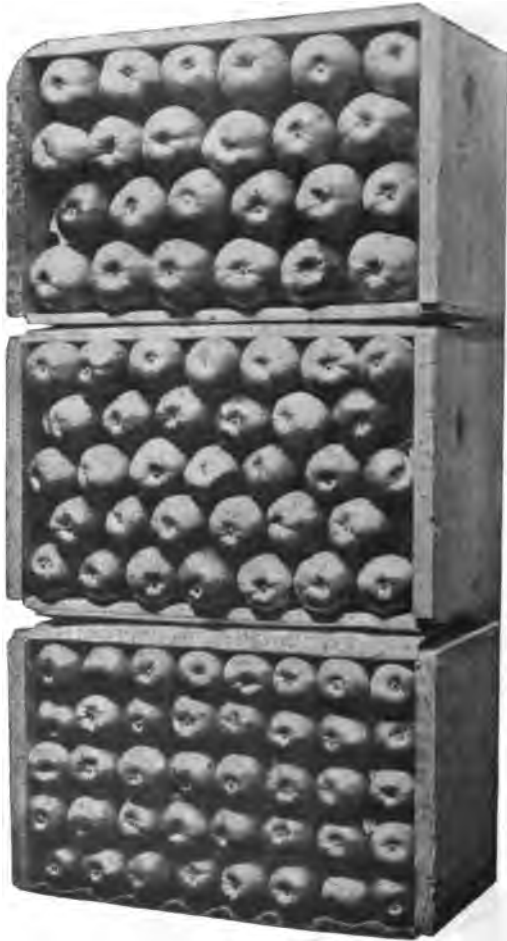


Fig. 20—Five-tier (200), four and one-half-tier (165), three and one-half-tier (96). Well packed, but should have stem end exposed to the cover.

that no mistake is made. While these boxes are the ones used, there is no law that says that we must use either one or the other; but we certainly need some legislation which will standardize our boxes. At present various sections of the United States are using boxes of varying capacity. Experience has shown that as regards

thickness of material the $\frac{3}{4}$ inch is the best for ends, $\frac{5}{8}$ for sides, and $\frac{1}{2}$ for top and bottom. These measurements are the best to avoid splitting, bruising of fruit, and to allow for proper elasticity.

PACKING PAPER, ETC.—A full supply of paper should be ordered. This will include box paper, layer paper, and wrapping paper, as described in other parts of this bulletin. Stencils and ink pads are also needed; and begin this season by putting in a good supply of lithographs. They are cheap and will pay good interest.

STYLES OF PACKS.

In speaking of styles of packs we refer only to those boxes where

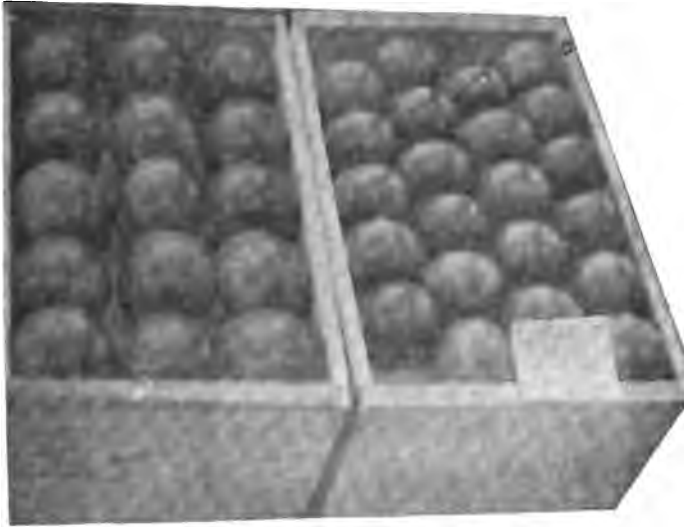


Fig. 21—Three-tier (45), three and one-half-tier (88).

each individual apple is laid in place and where an honest attempt is made to have all the apples in the box as nearly the same size as possible. The packers themselves have a great many terms relative to the various packs but the trade in general understands the packs only when designated as straight or diagonal. Formerly the offset was used considerably but is rapidly going out of favor. More people prefer to designate the packs as three, three and one-half, four, four and one-half, or five-tier, whichever they may be. It would be still clearer and more satisfactory to all parties if the number of apples were stamped on the box.

STRAIGHT.—In the straight pack the rows run straight across the box, parallel to the edges. This pack includes all the three, four, and five-tier apples. The straight pack is very neat in appearance but it is rather severe on the fruit, as each apple tends to be pressed



Fig. 22.—Three and one-half-tier (104 and 120), four-tier (128). All pack in the "special" box.

firmly against surrounding apples rather than into the spaces. We find the apples in the straight pack, as well as in the others, placed in various ways. Some pack the apple on its side; others pack with the stems up; while some have the calyx up. The best packs

should always have the bottom and top layers with stems toward the outside. In this way the apples do not tend to bruise as badly and if they do bruise are not so badly disfigured for the fruit stands where they are generally arranged with the calyx end up.



Fig. 23—Three and one-half-tier (104 and 96).

The three-tier pack consists, as the name suggests, of three rows across the box and also three deep, making, in the standard box, 45 apples (Figure 21), while if used with the special box it should contain 54 apples (Figure 19).

The four-tier consists of four rows across the top and four rows deep, including the 96 (6 tiers long), and the 128 (8 tiers long), (Figure 22), which are generally packed in a special box; the 112 (7 tiers long), (Figure 19), is also used.

The five-tier consists of five rows across the box and five deep. About the only pack used is the 200 (8 tiers long), (Figure 20). It does not pay to box smaller fruit than this.



Fig. 24.—Three and one-half-tier (64). In this case a poor pack—too many spaces showing.



Fig. 25.—Two and one-half-tier (36). This is not a commercial pack. Such large apples are undesirable for packing.

DIAGONAL.—The diagonal pack, or diamond



Fig. 26.—Three and one-half-tier (80).

pack, as it is often called, is so termed because the rows run diagonally with the edge of the box (Figure 23). Its chief advantage is that it accommodates sizes that do not adapt themselves readily to the straight pack, altho in some cases we find that the diagonal contains the same number of apples as certain straight packs. For instance, we have in the latter the four-tier, 96 and 112. These same numbers also occur in the diagonal. The diagonal pack contains the half-tiers, such as three and one-half and four and one-half (Figure 20). The two and one-half (Figure 25) is not a commercial

pack, being simply used to accommodate extra large apples on certain occasions. One of the advantages of the diagonal pack is that it allows the apples to adjust themselves more readily to the space

in the box; for when the pressure is brought to bear the apples tend to find the spaces, whereas in the straight packs each apple is always brought up firmly against its neighbors.

In the three and one-half we find that more than three full rows and yet not four full rows are necessary to fill the box. One can readily see, therefore, that a good many apples would naturally come in this class. We find more different packs being used with the three and one-half than with any other. In the standard boxes we have the 64 (Figure 24), 72 (Figure 19), 80 (Figure 26), 88 (Figure 21), and 112; while 96, 104 (Figure 22), and 120 are generally packed special.

In the four and one-half (Figure 20), we find that more than four full rows, but not five, are necessary to fill a box. This includes the 150, 165, and 175.

OFFSET.—The offset (Figure 27), should be discouraged, as too much empty space is left in the box. Large spaces occur in the side while in the diagonal there are only small spaces at the ends. Thus, in using the offset one sacrifices from four to twelve apples to the box. With fancy apples this means much to the retailer. The tendency, is, and should be, to get as many

apples as possible into the box; in other words, make the best use of the space. The time may come when we will have standard weights for each variety, which will denote the packing.

The packs described are all that are needed; in fact, more than the average man uses or should use. We should strive to do our packing with as few packs as possible, as a large number is confusing.

Fig. 27—Offset pack.



DETAILS OF PACKING.

No matter how good a product may be, unless it is packed in such a way as to reach the market in good condition, and at the same time be attractive, it will not bring the highest prices. But a good product, handled in an attractive package, is sure to be the first in demand and to command a good price even when the market is glutted. A certain grower in our state, by spending a few cents on each box of fine pears, realized seven dollars a box. It is almost a crime to handle some of the choice fruit in the way it is being handled. Of course, a certain percentage of the fruit is too small, too imperfect, to warrant the extra outlay. Nevertheless, an attractive package will often sell fruit that is not of the highest quality. That is, second grade fruit, if well packed, will often bring a profit

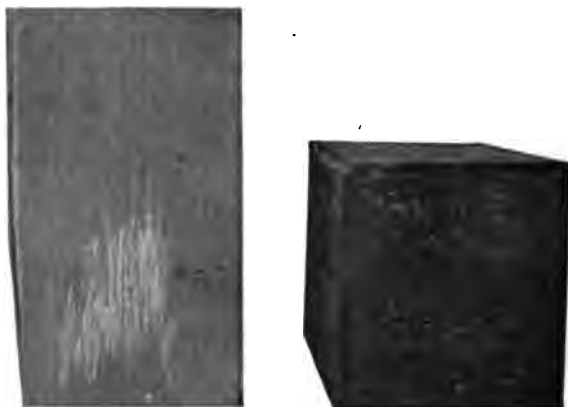


Fig. 28—Showing the proper bulge when nailed. (In making plate the bulge on one half of box was ruined.)

where there might otherwise be a loss; but what we should strive to do is to pack quality fruit in quality packages. In the very beginning it must be clearly understood that to receive the best returns one must not only understand the details of packing, which, after all, are matters of experience, but he must be strictly honest and scrupulously clean. These factors, coupled with correct methods, will surely bring success.

First, be sure the box is clean, and you will have no difficulty in always having clean boxes if you will purchase clean white material and never allow boxes to be used for any other purpose. The box is generally placed on an incline toward the packer, as shown in Figure 14. He is then ready for the lining paper. This paper is generally made slightly shorter than the box and about twenty-

six inches wide; thus two sheets are needed and this will allow for generous overlapping on both top and bottom, and also allow a plait to be made on the bottom corners. This can be easily done by catching the paper on the ends, thus making a fold, and then draw it quickly over the knee, creasing it. This crease is generally

Fig. 29—Three boxes—too flat, just right, too high.



made about six inches from the end. These plaits will fit in the corner and when the box is filled and bulged the paper will not tear. All boxes of high grade fruit should contain this paper as it insures keeping dirt and odors away from the fruit. Layer paper should also be used between the layers, especially for all fruit that is to be shipped a considerable distance. This paper acts as a pad, tends to lessen danger from bruising and skin slipping, soaks up moisture that may gather from sweating or bruising; and, moreover, aids to convey to the buyer the thought that he has a superior article. Both layer and lining paper should be constantly kept within easy reach of the packer and always in the same place to avoid confusion. Wrapping paper should be used for all the better grades of fruit. The 8x10 will answer most purposes. This paper often contains the name or trademark of the grower. It is not necessary to wrap all the apples with such costly paper, but it is a good plan to have the outside layers so wrapped and if the paper is neat it certainly adds much to the attractiveness of the package. This paper can very nicely be placed in little hoods that are made to clasp over the edge of the box (Figure 11). Some packers use a stall on the first finger or thumb to aid in

picking up the paper. Practically no time is lost in using the paper as an experienced packer picks up the apples with one hand while he reaches for the paper with the other. They are brought together very rapidly and a single twist wraps the apple. On the bottom and top layers the smooth side of the paper should be on the outside. Wrapping paper tends to make a firmer package, guards

against bruising, tends to keep the apples better, and certainly gives the package a superior air.

As to just how each pack is put up, the photographs bring that out. The straight packs need no explanation. The diagonal pack is generally started by putting the two or three apples in the lower left hand corner in first and then building up the lower layer on these. Each succeeding layer is made the same way. Experience alone will teach you how to pack so as to have the proper bulge in the center, as shown in Figures 28-30. Formerly our packers made this bulge altogether too great. It should be such that when the box is nailed you have a bulge not greater than three-fourths of an inch. The danger is that beginners will have the pack too flat, or else, in trying to obtain the proper bulge, will injure the apples or have the ends so high as to need extra cleating. If there is any difference at all in size of apples, place the smaller ones at the ends and the larger in the center. Again, if on the bottom layer the end rows are placed on the side and the center rows on end, it will tend to elevate the center. But with a little practice one should learn how to pack each box to the best advantage. These details one must thoroughly master for himself.

HANDLING THE PACKERS.

The best system of handling packers seems to be that in vogue with some of our associations, where the grower himself is not allowed to pack his own fruit. However, with our independent



Fig. 30—Same three boxes, Figure 19.

growers this is out of the question. Yet these men could often improve their pack if they would allow only the best packers to do this work, and try to retain the same men from year to year so far as possible. Whether packing is done by associations or by private

individuals, the principles are the same. A very common system is to pay by the day. The reason for the popularity of this method is that under it, so it is claimed, the packers take more pains. Such need not be the case. In fact, it is often quite otherwise. The packers lose interest in their work to quite a large degree and loiter whenever opportunity offers, when packing comparatively few boxes per day. If hired by the day, they should be divided into small groups and closely watched. In fact, better work is generally done where only a few packers are at work than where there is a large force, as it is impossible for one foreman to handle a large force.

The second system is packing by the box, of which method there are several modifications. In some places each packer packs by the box and the foreman is allowed to pack a certain number of boxes per day and for the rest of his time

is allowed a stated salary. Another modification of this method is not to allow the foreman to pack at all, and I believe this is the best way to secure a fancy pack. Everlasting vigilance must be the watchword; for it is true that where packing is done by the box



Fig. 81.—Storage and packing house, owned by J. W. Perkins.

there is a tendency at times in the great haste to be a little careless; but I believe that with close supervision better packing and more



Fig. 32—Loading the car.

of it can be done in a day than under any other system. One should always see to it that there is plenty of help at hand to assist

the packers, in bringing fruit and boxes, and removing boxes as fast as packed.

The prices paid for packing vary, but as a rule five cents a box



Fig. 33—How to brace a car to send across the continent.

is paid for all from three-tier to four and one-half tier, and six cents for the five-tier.

The apples should by all means be very closely culled and graded.

It is impossible to do good work unless this practice is strictly adhered to. Again, you cannot afford to do otherwise; it is expensive



Exhibit of A. I. Mason, winner of sweepstakes prize at Hood River apple fair.

to pay for packing poor apples and their presence will lower the

price of the package. Only quality fruit can bring high prices.

For associations just forming and desire to establish a system for handling packers, I know of no better regulations than those used by the Hood River Apple Growers' Association, and which are given in the appendix to this bulletin.

MARKING OF PACKAGE.

We find that there is no general uniformity in marking our fruit packages. It would be a work worth accomplishing if all of the growers of the northwest could come to some common understanding on this subject. Some growers stamp on the box the number of apples it contains, while others only stamp the number of tiers. Various letters are used denoting grades. More recently some growers are using lithographs to paste on the outside of the box. This past season the Hood River growers stamped on one end of the box at the center of the top the number of apples; under this was placed the name of the variety; in the upper right hand corner as you face the box is stamped the number of the grower; in the lower left hand corner the number of the packer. If the fruit in the box is not colored up to the standard, an L is stamped under the name of the variety. On the other end of the box is pasted a lithograph instead of the former ink stamping that was used. The lithograph has much to commend it. It is attractive and will in a way insure against that box being used again, unless new lithographs are used, as in transit the lithograph will be more or less defaced. It was suggested by one grower that these lithographs be made a little larger so as to paste over onto the top and bottom; thus, in opening the box they would become defaced in much the same way as a cigar box label. These lithographs should be selected with a good deal of care. Choose a design that is neat in composition and attractive in coloring. Bright, gaudy colors tend to cheapen the appearance of a package. A rather subdued, more natural effect adds much to attractiveness. Figure 18 shows four of these lithographs that have been used in Hood River.

Unfortunately growers in some states have sold fruit and stamped it as coming from a certain region in an adjoining state. In our own state fruit is bought from various sections and sometimes marked as coming from another. This is wrong—wrong to the buyer, wrong to the grower. Every grower and every association should be anxious to build up a reputation. To do this they must protect themselves. There is a move on foot now to have legislation passed similar to the Canadian laws outlined in the appendix. There should be a law requiring every grower to stamp his name and address on every box of fruit which he sells, and constituting it a criminal offence for anyone to efface the name. Then we could know where every box of our fruit comes from and each region would have a chance to build up an honest reputation and not be able to help or injure that of another region. We should also en-

courage a uniform system of marking our boxes, that there may be some common understanding on this matter.

STORAGE.

Thus far the greater bulk of our fruit has been shipped out early in the fall and few growers attempt to store for any length of time. However, we have some growers who do, and there will be a tendency as the production greatly increases to store at times, holding the fruit until the best prices prevail.

THREE TYPES OF STOREHOUSES.—There are several different kinds of storehouses. The best ones are those cooled by mechanical refrigeration. Ice storage stands next; and third, those houses cooled by ventilation. In most parts of the northwest the two former could not be considered and only the very largest handlers and associations could really afford such a plant. In our climate with its cool nights we can procure very good results from cooling by ventilation. We can open the houses at night, closing them in the heat of the day.

TEMPERATURE.—In building a storage house we must always keep in mind good ventilation, as otherwise much of the fruit will become musty. We should be able to modify the temperature. When it is warm outside, the temperature in the house will rise a few degrees; when very cold it will naturally drop a little. We must so construct the house as to prevent the interior from ever becoming heated and also from a freezing temperature. Different varieties of apples require different temperatures; but as the average grower has but few varieties his problem in this respect is rather simple. The best temperature, all things considered, lies between 32° and 40°.

MOISTURE.—Another factor worth taking into account is that of moisture. The houses should be so constructed that this can be controlled to a certain extent. If the houses become too dry there will be much trouble from shriveling of the fruit; if too moist, decays will spread rapidly. In constructing these houses it is better to have several walls with dead air spaces between, or make a double wall with a space of from nine inches to a foot, which will be filled with sawdust. Intakes for cool air should be arranged on the floor or at the bottom of the sides, and ventilators constructed in the top. By opening such a house at night and closing it daytimes, until the house becomes thoroughly chilled, fruit can be kept very nicely. In very severe weather the intakes for cold air can be closed.

HOW TO STORE FRUIT.—It pays to put only the best fruit in storage. Low grade fruit that is diseased or contains wormholes, bad bruises, skin cuts, or other injuries, should never be stored, as the germs of the storage rots will attack these exposed parts, causing a rapid decay which will at times spread through the whole house. Never put into your storage house fruit that is heated. Allow it to cool gradually before being placed in storage. Never store in deep bins. Use shallow bins, or better, boxes. Where fruit has been

handled properly it can be boxed and placed in storage in that condition; or, store in orchard boxes and pack just before shipping. After the fruit has been thoroughly graded and placed in storage, leave it alone. Handling does not seem to improve its keeping qualities. Figure 31 shows one of the best storage and packing houses in Oregon—that of Mr. J. W. Perkins of Medford. It contains three storage rooms that will hold two carloads each, and a large chilling room properly constructed and ventilated.

BI-PRODUCTS.

We have today in our orchards an enormous amount of fruit that should be utilized in some way—fruit that it will not pay to pack but which could be made into vinegar, canned, or evaporated. Millions of dollars worth of canned apples, pears, prunes, cherries, small fruits, and vegetables could easily be put up in our state every year. Many failures have resulted in the canning business, largely because the market conditions were not studied. There is little demand for fancy canned fruits, jams, or jellies put up in glass; but there is a big demand for plain canned goods put up with water and a little sugar in ordinary tin cans. One association in Washington has a factory the equipment of which cost about five hundred dollars. The growers of Puyallup, Washington, had seven thousand dollars worth of raspberries canned in one week the past season. Had it not been for the canneries, these berries would have been a total loss. Until recently the honest canner had to compete against the man who put up a little paste dyed and flavored with coal tar, but those days are gone and we should take advantage of the opportunities that lie before us.

LOADING A CAR.

The way in which a car is loaded will depend largely upon the kind of fruit, the season, and the distance to ship. The number of boxes will vary also with above named conditions. Where the standard sized boxes are used this will vary from five hundred to eight hundred, half sized boxes allowing twice as many. With such fruit as pears, fresh prunes, cherries, and peaches, ventilation spaces are left between the layers of boxes, and the top and center of the car is not filled, as in these parts the temperature ranges higher. Summer and early fall apples must be handled carefully when sent a considerable distance. All boxes must be laid on their sides and never on the top or bottom. Where refrigerator cars are used and icing is necessary, the car should be loaded as quickly as possible to prevent it from becoming heated and thus save the ice bill. Again, heated fruit should never be placed in an iced car. It will cause the fruit to sweat, and will also heat the air in the car. Gradually chill the fruit before loading. Figure 32 shows how the boxes are placed in the car. Cleats are nailed on the floor of the car so as to hold each row of boxes in place. Formerly every layer

of boxes was firmly cleated, but this year the results have been found good where the bottom layer has been firmly cleated and then every third layer so treated. The fruit should be loaded so as to prevent shifting. Figure 33 shows how the two halves of the car are firmly braced. If the cars are to cross the mountains during severe weather, they should be lined with paper to prevent freezing of the fruit.

HOW TO SELL THE PRODUCT.

DIRECTLY TO RETAILERS.—Even when we have packed our first-class product in the best way possible, we have still the problem of disposing of the same, altho it may practically sell itself. Nevertheless, judgement and careful dealing must be resorted to if we are to realize the highest returns. Some men enjoy soliciting the trade. To others this is distasteful. We have several paths to choose from. At times, by coming in touch with the retailers, we can find a good market and often realize the highest returns. One very successful cherry grower in our state realized wonderful results by means of letters to retail fruit dealers, choosing only one in a place and putting nothing but first-class material on the market.

THRU COMMISSION MEN.—The most common way is to dispose of the fruit to the commission man, with varied results. So much swindling has been done by this class of men that they have come into general disfavor, and often unjustly. Commission men are human. Some are honest; others are not. Many times the growers are at fault. They think they have handled the product nicely when nevertheless that same product arrives in the market in a fearful condition, and the low price is always blamed on the commission man. This summer I had occasion to wait at a depot several hours for a train. A number of large consignments of peaches were brought to be shipped three hundred miles by rail. In many cases I could run my hand in between the top of the peaches and the cover of the box and could in many of the boxes move the peaches. Imagine the condition of those peaches on a warm day in a city market. A great deal of thanks must be given to commission men, for the fruit industry in many localities owes its growth to their efforts, and it will be a long time before we can dispense with them entirely, if indeed we ever can, as the large commission men are very likely to obtain the fruit through whatever channels it is sent. Indeed, the commission business is so conducted that the chance to swindle is very easy. Fake accounts can be easily returned. The grower must rely entirely on the honesty of the commission man. Only in those cases where the fruit is bought outright for cash is he sure. It is no wonder, then, that much swindling is done and as a result the whole family of commission men must bear the stigma. It is largely their own fault. They tend to conduct their business on the plan that if there is any profit it is theirs, and if any loss, it goes to the grower. They should

change their methods if they desire confidence. This a large percentage are not in favor of doing and, in fact, will not do just so long as they have a large business under present methods. Before patronizing a commission man, be sure of his integrity; then try to follow his suggestions, and do not desert him if he does not bring you the highest price the first season.

THRU AN ORGANIZATION.—A third way of disposing of the fruit is through an organization, known as a union or association. I prefer the latter name as the former is distasteful to many buyers and suggests certain characteristics which a fruit growers' union should not have. There is nothing arbitrary about an association. It is simply an organization formed so that the grower can realize a fair profit; whereas, at the present time the crop is handled by so many middle men, each, of course, demanding a profit, that little, in proportion, is left to the grower. The outcome of successful associations all over this northwest will be a better profit to the grower without pushing the market beyond the reach of the common people. With more active associations fruit will retail cheaper, if anything; but the profits will go where they belong—to the man who grows the fruit.

FORMING AN ASSOCIATION.

ADVANTAGES OF.—I will outline briefly some of the advantages of an association. In fruit growing there are four things to be kept in mind: first, we must grow a first class product. This means up-to-date methods. Second, we must pack our product with skill and great care, keeping constantly in mind quality, cleanliness and honesty. Third, having grown and packed this splendid product, we must feel that we ourselves have something good. And fourth, knowing ourselves that we have something good, we must let other people know it—in other words, advertise. All these things the association fosters and in all of these does such an association as the Hood River Apple Growers' Union excel.

The association demands that fruit receive the best of care. To produce the quality of fruit required, one must carefully thin and prune and spray and keep the trees in good vigor by thorough cultivation. In the special instructions to growers given in the appendix you will note the quality of the fruit required; and right at this point the association can be of great service to the grower because they can buy spraying materials, tools, etc., in carload lots, thus making a great saving for the grower. The best grading and packing done in the state is through an association. This is borne out by the fact that the fruit from Hood River this year was received without inspection in the New York and Liverpool markets. You cannot grade and pack your own fruit as nicely as someone else can do it for you. Our own eyes are often too small to detect blemishes that the unbiased eye can easily discover. It is only by very close inspection of every individual specimen that the fancy

pack can be realized. If there are any men who know a good thing when they have it, they are the members of our associations. This knowledge has taught them the fourth requisite—that is, advertising. In all lines of business today it is realized that advertising certainly pays. There has been no exception to the rule in fruit growing. The people who are realizing the largest returns are the people who advertise. The finest investment an association can make is to donate a few boxes of apples where they can make an impression. Thus, when the letter carriers had their convention in Portland, a certain organization donated several boxes of apples, each box costing the association about eleven dollars. Each apple was wrapped in a silk wrapper with appropriate lettering. Other conventions have been handsomely remembered. These apples have graced the tables of the finest banquets of the country. Our men of wealth, our lawmakers, our foreign ambassadors, all sing the praises of this Oregon organization, and advertising has accomplished this. Another splendid way to advertise is to hold fairs, as we do, and have other public exhibitions. Place fruit in city show windows, and in many other ways get it before the public eye. There is one kind of advertising that most of the Oregon growers can improve upon, and that is the kind of banners they put on their cars. They should in many cases be more conspicuous, and carry at a flash the fact that it is Oregon fruit which they herald, naming the localities. These cars go all over the United States.

An association can afford in a very short time to hire a manager and have him give all his time and energy to placing the product on the market. Men can be hired to do this for a small commission. It will by all means pay the association to make this liberal enough to secure the services of a man of ability. The more the association makes the more he makes. He therefore has an incentive to bring about the best possible results, devoting all his time to the work. He can receive daily quotations and even change the destination of a car already en route, thus not allowing a consignment of fruit to reach a glutted market. The association, because it handles such a large quantity of fruit, can, if necessary, hire at destination a private inspector. Again, the problem of storing and shipping is handled more cheaply than can possibly be done by the independent grower. Better shipping facilities can often be secured from railroads because of the volume of business. While the individual large growers can, and do in many cases, put a splendid product on the market, the keen competition of the growers of an association will generally produce a superior article. Our independent grower is too busy to attend to all the details of growing, and in packing he must hire and manage the work himself. He can build up a market for his fruit, but few can accomplish this with the ease and at the low cost of the association. The bi-products

will become more and more important each year and the associations can afford to build canning and vinegar factories, and in some cases have already done so with splendid results. As time goes on they can make their own boxes. Problems of storage are often simplified, as, if necessary, the association can afford to build well equipped storage plants. There are many other advantages too numerous to speak of. It is sometimes stated that the prices will fall and that associations will no longer pay. Take for granted that prices will fall from the present standard. This much is sure—that the best handled fruit will always bring the best prices and give the best profit.

HOOD RIVER METHODS.—The methods of the Hood River Apple Growers' Union are quite simple. When the driver delivers a load of fruit at the warehouse, he is given a slip in the form of a receipt for the fruit. There is a duplicate of this retained at the office and it is entered on the debit side of the ledger. At the time the fruit is loaded into the car it is checked up and entered on the credit side. When the check is received, each grower is credited his share less the charges of the Union.

The Hood River organization now has a membership of over one hundred and controls approximately ninety per cent. of the fruit of the valley. In four years it has been able to raise the price from 85 cents to \$3.15 for the best grade of Spitzenbergs, and \$2.50 for the best Yellow Newtowns. The prices range somewhat as regards size and quality. As an experiment this past fall the association sent nine carloads of fall apples to England. These apples were selling here at approximately 85 cents a box. After all expenses were paid they netted the Hood River growers \$1.32 per box. Some associations expect to realize such returns at the very start, and if they cannot they become dissatisfied. It takes time to build up a strong organization and to gain a reputation; but remember that even at a dollar a box you can realize a fair profit.

STEPS IN FORMING AN ORGANIZATION.—You do not need to try to form a large organization the first season. Good results can be realized by a few growers pooling together; then the next season branch out. Send some forceful member about to visit the growers and lay before them the advantages of an association, and call a general meeting. At this meeting choose a committee to draw up by-laws and constitution to be acted upon at some future meeting, when they will be adopted, and such officers as president, treasurer, and secretary, managers, and board of directors will be chosen. Have each member sign the constitution. It will generally be well to incorporate. To do this, simply file the names of the directors and a copy of the by-laws with the state auditor, and pay a small fee. It is generally advisable to issue stock—say, at five or ten dollars a share, requiring a fourth or half to be paid in. Oblige every member to take at least one share. It is at this point where some of our

associations are weak. In their early struggles they will sell shares to anyone who cares to buy. This is a mistake. The growers should always control the organization. It would not be a bad plan when the final steps are to be taken in completing the organization, to invite some of the members of a successful organization to attend and aid in the work. To do away with petty jealousies it is often much better to have an outsider come in and act as manager. As a general rule a business man has had the training that will make him more skillful than the average grower. It will pay to reward a capable man. Some organizations have had trouble in holding the buyers and also the growers to terms. Outsiders will come in who desire to injure the association so that in the future they can control the market. Make the buyers sign a legal contract and deposit a forfeit. In the fall after the crop is handled, plan for the next season and have a contract drawn up for the grower to sign. Do not put this off later than spring. Those who object to such a plan are not the men you desire. Rather have an organization of twenty sincere members than a hundred knockers and backsliders. In time you can build up a reputation so that the buyers will come to you and will do as they did at Hood River this year—camp out for weeks and at a given time hand in their sealed bids. There is only one danger in the sealed bids proposition, and that is that at some times the buyers might pool and divide the spoils. Have a good supply of by-laws and regulations printed and issue these to every member. It is the duty of each and every member to become familiar with these by-laws and to aid the officers of the association in every way possible. If a manager must constantly remind the members of the by-laws he wastes much time and cannot give his best efforts to his duties.

It would be a good plan if all the associations of the state would have their officers meet once a year and discuss plans for improving methods, and thus build up the fruit industry of the state. This meeting could come at or about the time of the meetings of the State Horticultural Society.

There is plenty of room for all and a wonderful chance for development. Instead of hindering, we should always try to aid each other in every way possible. The associations should also take an interest in the Northwest Fruit Growers' Association, which meets once a year and which can do much valuable work in drawing up desirable regulations and laws.

C. I. LEWIS.

Written by E. H. Shepard.

APPENDIX I.

Hood River Apple Growers' Union.—Advice to Growers.

1. Pick all apples as soon as they have attained their proper size, color and maturity, and save loss from dropping. In picking be careful not to pull off fruit spurs or stems. Your pickers, packers and wrappers must not bruise apples by dropping into the bucket or basket or in transferring from the field box. Be careful and do not allow pickers, packers or wrappers to break off stems of apples.

2. The Union will notify you all by mail when a variety is to be packed and how. Upon receipt of such notice, pick, wipe and have all arrangements made for packers, as follows: Packing house, boxes, paper, packing table, nailing machine, nails, etc. Notify the Union when you are advised a variety is sold when you will be ready for packers. Packers will be sent to growers in order of notification.

3. The packing house should be arranged to let in plenty of light, and keep out as much wind as possible. Provide sufficient lamp light for late in the afternoon, as it gets dark early.

4. PACKING TABLE.—Each grower should have tables for four packers. Be sure and get one.

5. PAPER.—See that you have plenty on hand for your crop. Carload for sale at Union; price, cost laid down.

6. BOXES.—Have sufficient number on hand. *Keep them clean. Do not pack fancy fruit in dirty boxes.* Dirty boxes buyers will not receive. Therefore, the Union will decline to accept them.

7. SORTING.—Cull out all wormy, scabby, scaley, bruised, misshapen or otherwise imperfect apples. Packers, in final sorting at prices agreed will not be required to cull out more than 8 boxes in 100 without extra pay. Sort your apples into the standard or special box, whatever they will most likely pack into to the best advantage. This will save a great deal of time. Growers in sorting are requested to put 4-tier and larger in boxes by themselves and all 4½ and 5-tier in boxes together.

8. WIPING.—See that all apples are properly wiped for the packers. In piling boxes after sorting, put cleats between so apples won't bruise.

9. APPLES ON PACKING TABLE—Growers will be expected to see that the packing tables are kept properly filled for packers.

10. PAPER AND BOXES HANDY.—See that empty boxes and paper are conveniently arranged for the packers.

11. SETTING OFF BOXES.—Each packer will be required to set off

his own box and put on the lower left hand corner of the end of the box with a rubber stamp his packer's number.

12. **STENCILING BOX.**—Each packer will write on the end of the box the number of apples contained in the box. The grower or foreman will stamp on the end of the box, in the middle at the top, the number of apples contained in the box, and underneath the name of the variety. A complete set of stamps for this purpose will be carried by each foreman of a gang.

13. **GROWER'S NUMBER.**—Each grower will be required to put on his number with a rubber stamp in the upper right hand corner of the end. If you do not have a number, call at the office and one will be presented free. If you do not fully understand the stamping of the boxes, ask the foreman of packers, or the manager will explain.

14. All stamping must be on one end of the box.

15. Packers must pack apples so that they will not be above the top of the box on either end. Growers will be allowed to refuse to nail a box unless so packed. If absolutely unavoidable in very large apples, the grower will be sure to put on cleats under the lid at both ends.

16. **PILING AND LOADING.**—Pile your boxes, after being packed, on the sides and load in the wagon the same way.

17. **HAULING.**—Haul on springs and use a wagon cover to keep off dust and rain.

18. All boxes should have four nails on sides, tops and bottoms. A great many boxes came in last year bursted. We therefore request you to use 5 or 6 penny cement coated nails, which are the only proper nail to use.

19. **FINALLY**—We grow fancy fruit. Our reputation and prices this year and in the future depend on our pack. Do all you can to assist the board of directors in carrying out their plans. These requests are made by them for your interests.

INSTRUCTIONS TO PACKERS.

1. A crew will consist of four packers, including foreman.

2. Each packer, before he is permitted to pack for the Apple Growers' Union, must have his name registered at the office of the Union and receive a rubber stamp free. He shall be required to stamp each box at the lower left hand corner when packed with his official stamp.

3. Each packer shall be required to put up a first-class pack. If upon any inspection any packer be found guilty of putting up a poor pack, or putting in apples not suitable for the pack being made, he shall bear the expense of repacking such box or boxes for the first two offences. Upon further neglect he shall be dropped from the list of the Apple Growers' Union packers.

4. Each packer, when a box is packed, shall write with pencil up-

on the end of the box, in the center near the top, the number of apples the box contains.

5. Each box of apples shall be packed with about a $\frac{3}{4}$ -inch to 1-inch swell in the middle of top and bottom combined, but no box must be packed so high that it will be necessary to cleat the box before nailing on the lid.

6. Each packer shall receive his pay from the grower in cash, or a written order on the Apple Growers' Union, which will be cashed by the manager on presentation.

7. The charges fixed by the Union and agreed to by the packers for packing, will be 5 cents per box for all boxes containing 128 apples or less, and 6 cents per box for all boxes packing $4\frac{1}{2}$ tier. All 5 tier apples will be packed at 7 cents. This price shall cover any and all packs ordered by the manager.

8. Each packer will be furnished meals by the grower where he is packing, without charge, but must make necessary arrangements for his bedding.

9. Packers are required only to pack fruit properly wiped and assorted from culls fairly well by the grower before being placed on the packing table, but the packer will be required to make the final culling, which shall not exceed 8 per cent, or 8 boxes in 100. Such culls as the packer may throw out he will be required to handle with as much care as first-class fruit.

10. Each packer must be supplied with suitable and necessary room at the packing table, which must be properly and substantially made.

11. Each packer shall require the grower to supply him with empty boxes, and have the proper paper placed in a convenient place.

12. Each packer must set off his box when packed.

13. If the grower is not properly prepared for packers, the packers are at liberty to move on, or may charge the grower at the rate of 20 cents an hour for extra time spent in culling and wiping properly. It shall be the duty of each packer to notify the grower of such conditions, when existing, in advance, and should the grower make a protest, the packer will be at liberty to move on and report the matter to the manager, who will endeavor to conscientiously adjust the matter satisfactorily.

14. Packers must be sure to have the exact number of apples in the box as numbered. Foremen are cautioned to watch this. Avoid criticism by following this instruction. We are on the lookout for this sleight of hand trick.

15. Please assist the packer. He is also a grower and your friend; and remember he is following instructions given by the Board of Directors, who are acting as directors with your interest at heart, giving one day each week of their time without pay.

BY ORDER OF THE BOARD.

APPENDIX II.—Special Instructions to Apple Packers.

Only two stings on one apple will be accepted on all first grade apples. Any worm sting must not be larger than 3-16 of an inch in diameter measured from outside of green ring around said sting. No sting may show an open hole; 4½ and 5 tier apples should not show over one sting unless said stings are very small. Limb and leaf rubbed or other like defects will be accepted where said defect does not break the skin of the apple, providing said defect is not larger than a 10-cent piece, if said defect is circular; if it is oblong in shape it must not be more than 3-8 of an inch wide and 3-4 of an inch long. This shall also apply to defects caused by cut worms while small, providing any defect does not materially affect the shape of the apple. Stemless apples will be accepted when the flesh of the apple surrounding said stem is not broken. All apples must be clean, fully matured, of good color, free from any insect pests, fungus, rust, decay or injury except as herein specified. Deformed apples will not be accepted. Packers are cautioned to look out for windfalls and bruised apples. Green apples that will never mature will not be accepted. All apples must be wrapped, boxes lined, layer paper between layers on top and bottom. Spitzenbergs, Newtowns, Ortleys, Aiken Reds and Red Cheek Pippins must be wrapped with top and bottom layers in printed wrappers, middle layer plain paper. All other varieties must be put up the same way unless otherwise ordered. Spitzenbergs sold as red must have 70 per cent or more red color. Spitzenbergs and Newtowns that pack 5 tier must be packed in Oregon boxes. This does not apply to other varieties. These instructions will be followed on all our packs, except the clause pertaining to color, on which special instructions will be given for the different varieties.

4 tier apples include nothing smaller than 128 size.

144 size is special.

4½ tier includes 150 to 175 size.

5 tier includes 185 to 200 size.

Do not pack in dirty boxes.

Everyone should keep his hand clean so as not to soil the paper or dirty the boxes in handling.

APPENDIX III.—Office Hood River Apple Growers Union.

HOOD RIVER, Sept. 22, 1906.

All apples will be wrapped this year, boxes lined, layer paper between layers and on top and bottom. Printed wrappers will be used on top and bottom layers, plain paper for the middle layers; therefore, order half printed wrappers and half plain wrappers. Using printed wrappers this year will only add three-fourths of a cent per box.

The crop packs out in general one-half in Oregon boxes and one-half in California boxes. We would suggest in a general way ordering half of each size box, and paper the same way.

Mr. Geo. I. Sargent, late from California, who had charge of a four hundred acre orchard there, is using the system of sorting apples adopted in California canneries. Briefly, he cuts three circular holes in a board, 2¾ inches, 3 inches, and 3¾ inches in diameter, which he hangs up in front of the sorter. This being just in front of the eye and within reach of the hand, enables the wiper, when wiping and sorting, to quickly see or determine the size of the apple, and it is accordingly placed in a 3, 3¾, 4 or 4½ tier box. It is just as quick to place each apple in the proper box as it is to put them all in one box. All apples less than 2¾ inch hole go in 4½ and 5 tier boxes.

The great advantage of this system is that your packers can pack directly from the box, or if placed on packing table you avoid having all sizes on at once, which means, as you know, a whole lot of pawing over and bruising

more or less, which must necessarily affect the value of apples in the market. The less bruising we have the more our apples will bring, consequently the more buyers will be willing to pay us in future.

Mr. Sargent says it costs no more to sort in this way than when putting all sizes in one box.

The crew of four now packing say it is the slickest and best system they ever saw. They packed out two hundred and eighty boxes the first day.

We would like to see the growers try this, because we believe it will enable us to pack the crop a great deal easier and quicker. And we believe this system will eliminate so much unnecessary bruising caused by pawing over a lot of different sized apples that our crop handled by this system will bring us more money.

If you do not thoroughly understand it, call at the office for explanation.

Growers are requested to wipe their apples and put nothing on the packing table but what is absolutely A-1 stock. Above all things, be sure and cull out all apples showing scale or fungus, for the reason that either one of these diseases would cause a car to be rejected or turned down by an inspector quicker than anything else.

Fancy prices have been realized this year and we must "make good" by putting up fancy apples. This will insure us fancy prices next year. We must maintain our reputation. If we do not we can not expect high prices.

HOOD RIVER APPLE GROWERS UNION,

E. H. SHEPARD, Manager.

APPENDIX IV.—Hood River Fruit Growers' Union.

Articles of Incorporation and By-Laws.

Art. 1. The name of this corporation shall be "The Hood River Fruit Growers' Union."

Art. 2. The objects of this corporation shall be to secure to fruit growers of Hood River valley and vicinity all possible advantages in the marketing of their fruit, as well as to build up a standard of excellence, and to create a demand for the same.

Art. 3. The principal place of business of this corporation shall be at Hood River, Wasco County, State of Oregon.

Art. 4. The capital stock of this corporation shall be one thousand five hundred dollars (\$1500).

Art. 5. The value of each share of such capital stock shall be five dollars (\$5).

BY-LAWS.

Section 1. The name, place of business, capital stock and purposes of this corporation are set forth in the articles of incorporation, which are referred to as a part of these By-Laws.

Sec. 2. The directors of this corporation shall be five in number, who shall be elected annually, and shall serve until their successors are elected and qualified. They shall qualify as directors within five days after their election, and within ten days thereafter they shall elect from their number a president, vice-president and secretary. They shall also choose a treasurer, who shall be required to give bonds, with surety, in such sums as they may deem ample. They may choose a bank as treasurer without bonds.

Sec. 3. The directors shall have power to levy and collect assessments on the capital stock, the same to become delinquent in thirty days from date of notice in local paper of such assessment. The directors may sell such delinquent stock at public auction to the highest bidder for cash, first giving thirty

days' notice of such sale in a local newspaper, such sale to be made at the door of the office of the Union, in Hood River, Oregon.

Sec. 4. The directors shall employ such agents and other employees as are necessary to do the business of the corporation, and shall fix the remuneration.

Sec. 5. The directors may refuse to receive for shipment any fruit not considered prime for any cause. They may also refuse to receive fruit for shipment from any person who has not shipped with the Union regularly heretofore during the shipping season for such fruit, when in their judgment the receiving and shipment of the same would be detrimental to the interests of the regular shippers of the Union.

Sec. 6. The duties of the secretary shall be to keep all books and accounts and records of the corporation, and to keep the minutes of the proceedings of the directors' and stockholders' meetings, and to carry on all correspondence, and to perform such other duties as may be required by the board of directors.

Sec. 7. The duties of the president and vice-president shall be the same as are usually required of such officers.

Sec. 8. It shall be the duty of the treasurer to receive and pay out all funds of the corporation, and to keep a correct account of the same.

Sec. 9. The annual meeting for the election of officers and the transaction of other business of the corporation shall be held on the second Saturday in November of each year, in the town of Hood River, Oregon, at 10 o'clock a. m.

Sec. 10. The president shall instruct the secretary to call a meeting of the stockholders whenever in his judgment the necessities of the Union require it, by giving one week's notice through the local newspaper and by posting notices in three conspicuous places.

Sec. 11. A majority of the stock subscribed, upon which all legal calls or assessments are paid in full, shall constitute a quorum at any stockholders' meeting, and no vote shall be counted which is not represented by at least one share of stock upon which all calls or assessments have been paid.

Sec. 12. These By-Laws may be amended by a vote of a majority of the stock upon which all calls or assessments have been paid in full, at any regular or called meeting, provided that notice to amend By-Laws shall have been given in the call for the meeting.

Sec. 13. The board of directors shall have the power to fill any vacancies that may occur in their number.

APPENDIX V.—Canadian Fruit Marks Act, 1901.

[Extracts.]

4. Every person who, by himself or through the agency of another person, packs fruit in a closed package intended for sale, shall cause the package to be marked in a plain and indelible manner, before it is taken from the premises where it is packed —

- (a) with the initials of his Christian name, and his full surname and address;
- (b) with the name of the variety or varieties; and

(c) with a designation of the grade of fruit, which shall include one of the following six marks: for fruit of the first quality, No. 1, or XXX; for fruit of the second quality, No. 2, or XX; and for fruit of the third quality, No. 3, or X; but the said mark may be accompanied by any other designation of grade, provided that designation is not inconsistent with or marked more conspicuously than, the one of the said six marks which is used on the said package.

5. No person shall sell, or offer, expose or have in his possession for sale, any fruit packed in a closed package and intended for sale, unless such package is marked as required by the next preceding section.

6. No person shall sell, or offer, expose or have in his possession for sale, any fruit packed in a closed package, upon which package is marked any des-

ignation which represents such fruit as of No. 1 or XXX. finest, best, or extra good quality, unless such fruit consists of well-grown specimens of one variety, sound, of nearly uniform size, of good colour for the variety, of normal shape, and not less than ninety per cent free from scab, worm holes, bruises and other defects, and properly packed.

7. No person shall sell, or offer, expose or have in his possession for sale, any fruit packed in any package in which the faced or shown surface gives a false representation of the contents of such package; and it shall be considered a false representation when more than fifteen per cent of such fruit is substantially smaller in size than, or inferior in grade to, or different in variety from, the faced or shown surface of such package.

8. Every person who, by himself or through the agency of another person, violates any of the provisions of this Act shall, for each offense, upon summary conviction, be liable to a fine not exceeding one dollar and not less than twenty-five cents for each package which is packed, sold, offered, exposed or had in possession for sale contrary to the provisions of this Act, together with the costs of prosecution; and in default of payment of such fine and costs, shall be liable to imprisonment, with or without hard labour, for a term not exceeding one month, unless such fine and the costs of enforcing it are sooner paid.

9. Whenever any fruit in any package is found to be so packed that the faced or shown surface gives a false representation of the contents of the package, any inspector charged with the enforcement of this Act may mark the words "falsely packed" in a plain and indelible manner on the package.

(2) Whenever any fruit packed in a closed package is found to be falsely marked, the said inspector may efface such false marks and mark the words "falsely packed" in a plain and indelible manner on the package.

(3) The inspector shall give notice, by letter or telegram, to the packer whose name is marked on the package, before he marks the words "falsely packed" or "falsely marked" on the package.

10. Every person who not being an inspector wilfully alters, effaces or obliterates wholly or partially, or causes to be altered, effaced or obliterated, any marks on any package which has undergone inspection shall incur a penalty of forty dollars.

Explanation for Guidance of Inspectors.

SEC. 6. 'No. 1 or XXX, finest, best or extra good quality.' The following marks also are held by the trade generally to indicate this quality of fruit: 'Choice,' 'Fancy,' 'Selected,' 'Prime.'

'Nearly Uniform' is to be taken as including any size of fruit except that which may be fairly classed as *small for the variety*.

'Bruises.' Only such injuries as produce decay or otherwise materially lessen the value of the fruit for consumption, should be counted as bruises.

'Scab.' Such as causes appreciable waste to be considered particularly.

'Properly Packed.' 'Slacks' are to be considered as not properly packed if the condition is likely to result in permanent damage during handling or transit.

Explanatory Notes for the Owner.

If the owner marks the package 'No. 1' (or XXX) the fruit must be described in Section 6. practically perfect. On reading this section carefully, it will be seen that the packer should aim to discard every injured or defective fruit, and not to deliberately include the ten per cent of inferior specimens which the law allows. This margin is meant to make the work of grading easier and more rapid than if absolute perfection were exacted in the first grade, as many of the best growers think should be done.

It should be noted that the definition of No. 1 fruit does not vary from year to year; no provision is made for lowering the standard when the quality of the crop is poor. In such a case the only result is that a smaller proportion of the fruit is No. 1.

The Act makes no restriction as to the quality of fruit which is marked 'No. 2' or 'No. 3,' but it is strongly recommended that 'No. 2' consist of fruit in every way as good as 'No. 1' except in the matter of size and colour. 'No. 3' will then include all under-sized or defective specimens which are marketable, culls being left at home.

By carefully following the above method, owners will soon establish a high reputation, particularly if they export very few of the 'No. 3' grade.

On the owner is laid the duty of seeing that the face of each package fairly represents the contents as required by Section 7. Over-facing is an offense against the Act which is most severely dealt with by the courts.

10,000.



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Department of Bacteriology.

Oregon Agricultural Experiment Station.

CORVALLIS, OREGON.

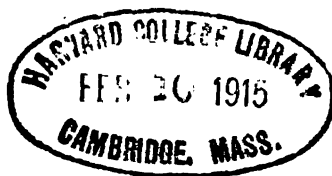
DISEASE OF TURKEYS

(INFECTIOUS ENTERO-HEPATITIS)

By E. F. PERNOT.

**THE BULLETINS OF THIS STATION ARE SENT FREE TO ALL RESIDENTS
OF OREGON WHO REQUEST THEM.**

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INFECTIOUS ENTERO-HEPATITIS.

"BLACK HEAD."

Turkey raising in some parts of Oregon is developing into a profitable industry. During the holiday season of the past year the local dealers inform us that some turkeys netted the producer from 16 to 18 cents per pound each.

Taking this as a basis, and considering the small expenditure which turkeys require where they have access to a large range, the industry is a profitable one, providing that the fowls escape the ravages of contagious diseases.

Young turkeys are very delicate and require a great deal of care. Many of them die when very young of acute indigestion from improper feeding and from exposure to wet and cold. Such losses are frequently attributed to contagious disease, merely because many are subjected to the same conditions at the same time.

The most destructive disease which has come to our notice, attacking both old and young turkeys, is Entero-Hepatitis, sometimes known as "black head." The latter term is a common one owing to a peculiar dark color which the head assumes when the disease is at its height, but this is merely a manifestation of disease situated in some other part of its anatomy.

Entero-Hepatitis is an intestinal disease situated in the free ends of the caeca, and is caused by a parasitic protozoa named by Smith *Amoeba meleagridis*; as this is what may be termed a feeding disease, the parasite enters the body with food or drink, finally finding lodgement in the mucous membrane of the caeca or in the liver. There it multiplies and causes an inflammation which finally destroys the mucous membrane. The affected caecum is very much enlarged and filled with fecal matter sometimes giving it a dark blue-black appearance, at other times it may be filled with a yellowish slimy mass, which when ejected adheres to the feathers in the vicinity of the anus. Either or both of the caeca may be affected, and be empty and shrunken, as seen in Plate 1, Fig. II, which had only one large ulcerated spot at the point marked X, this, however, does not show well in the illustration. Cutting the caecum in two at this point, there is a fibrinous growth adhering to the inner wall which nearly fills the passage.

A very fine, large bird dissected February 18 had one free end of the caeca badly affected, while the other was nearly normal. The affected one was about twice its normal size, stuffed like a sausage at its extremity and of a blue-black color. Midway and on the side nearest its companion, there was an irregular circular spot about the size of a ten-cent piece, resembling an ulceration. The spot was of a mottled red and yellow color surrounded by an angry red zone, showing an acute inflammation. There were no signs of disease in any other part of the digestive tract, but the liver was very seriously affected, being

PLATE I.



FIG. I—Healthy caeca.

FIG. II—Diseased caeca.



**Plate II. Liver of Diseased Turkey,
one-half natural size.
(Original).**

about twice its normal size, dark in color and filled throughout with yellow spots varying in shape and size. But few of these spots have a definite outline, and the color varies from a mottled yellow to a dark brown, which merges into the surrounding tissue; they are flat, and sometimes depressed below the surface of the liver. Some of the larger ones, however, are raised like blisters. These spots are composed of dead liver tissue, and are the disease centers where the parasites may be found. See Plate II.

The liver is not always affected, as we have dissected birds in which there were no other lesions except in the free ends of the caeca.

CAUSE OF THE DISEASE.

As before stated, this disease is caused by protozoa, animal parasites which are from one to four times as large as blood corpuscles. They can only be detected by the aid of a microscope, and slides properly prepared for it. They are more or less circular in form, and have a nucleated granular spot usually near the center. Because of their minuteness, and growth in the mucous membranes of the digestive tract, they are easily carried by the excreta to food which, upon becoming contaminated, transmits them to other fowls. This is the usual means of infection.

After the disease is established in the caeca the parasites are probably carried by the blood to the liver, where they again find a suitable medium to grow in, causing the diseased areas already described.

At the same time they are no doubt carried by the circulatory system to all parts of the body, but as we have found no other lesions except in the caeca and liver, it is to be inferred that these are the principal seats of disease, yet the blackening of the head which occurs at times is probably due to growths of the parasites causing thrombosis, a damming of the blood, which would indicate that they do grow elsewhere than in the liver and caeca, although we have never found this to be positively the case.

SYMPTOMS.

The symptoms of this disease where the contagion takes place under ordinary conditions, are not always of a pronounced character, and we have to largely depend upon descriptions given us by owners of the fowl who do not observe the earlier stages. In fact, their attention is usually not called to it until the disease has advanced to a dangerous point, or death has occurred in one or more fowls.

The most pronounced symptom is diarrhoea which, once begun, is constant. The discharges are frequent, thin, watery and generally of a yellowish color. This, however, sometimes occurs from other intestinal disorders, such as tapeworms, or bacterial irritation, and therefore cannot alone signify that they are afflicted with this particular malady. If the affection first occurs in the caeca, diarrhoea will appear earlier than if it were in the liver, for the disease in the liver must progress to such

a stage as to interfere with the gall ducts discharging the contents of the gall bladder into the intestines, thus interfering with digestion and causing diarrhoea; the next symptom is a drooping of the tail, followed by a drooping of the wings, after which death soon ensues.

If a blackening of the head occurs, by an engorgement of blood, it takes place about the time when the tail droops and usually continues until death. The affected birds have fickle appetites and mope about; in chronic cases they become emaciated, whereas in the acute form, when both liver and caeca are affected, they die before there is any appreciable wasting away.

We have received specimens of full-grown birds, which were in fine condition, fat and plump, no symptoms of disease was noticed in them until shortly before death. In these cases both liver and caeca were seriously affected, showing that the disease had made such rapid progress that wasting away had not occurred. The disease also becomes chronic sometimes in a mild form, from which the birds eventually recover.

Young turkeys are much more susceptible than are the older ones, or they may be more delicate and cannot withstand the invasion of the parasites so well; however this may be, they succumb very readily to the disease.

The symptoms are similar to those of older birds, and even more pronounced. They begin by moping and hunching up as if they were cold, diarrhoea soon sets in, the tail droops, then the wings drop and they go about uttering a pitiful "peep," after which they soon die. A blackening of the head does not always occur.

It must be remembered that the symptoms of many of the diseases, especially in young fowls, are so nearly alike that by the symptoms alone the nature of the disease cannot be ascertained.

It is only upon a careful post mortem examination that the true cause of disease may be determined.

When a poultry raiser is uncertain of his own diagnosis, this Station is always willing to do it for him free of charge, provided the specimens are forwarded prepaid, accompanied by a good description of the symptoms observed.

REMEDIES.

It has been pointed out that Entero-Hepatitis is caused by a microscopic parasite which passes with the excreta from diseased turkeys. Whether these pass a part of their life cycle outside of the living bird, is not known, nor do we know how long they will retain their vitality after expulsion. Suffice it to say that the diseased bird scatters many of them in the vicinity in which other fowls are fed; therefore the first step towards remedy is prevention. Food given to fowls should *never come in contact with their droppings.*

We know that it is customary, especially on the farm, or in places where poultry is confined to small runs, to scatter grain to fowls where

they are compelled to pick it out of their excreta. By this means bacterial diseases and intestinal parasites are passed from fowl to fowl.

There is more tuberculosis spread in this way than by all other means combined, and there are more fowls affected with tuberculosis than all other diseases combined.

So it is with Entero-Hepatitis, one bird with an advanced case of the disease, will infect the feeding ground of others.

It would be far better to sacrifice that bird at once than risk spreading the infection to the whole flock.

This holds good with any other disease. A sick bird should be removed from the flock and placed in close quarters which may afterwards be disinfected, or the bird may be killed at once and burned. This precaution is worth many times the value of the one sacrificed.

When Entero-Hepatitis once becomes established medical treatment is not very successful, owing to the difficulty of reaching the parasites at the seat of disease, yet, treating them with some of the following remedies is well worth the trouble.

An outbreak occurred in the flock of full-grown turkeys belonging to Mr. T. A. Logsdon, from which five died before the cause was discovered. A treatment with Sulphur—5 grains, Sulphate of Iron—1 grain, Sulphate of Quinine—1 grain, was tried. This amount was placed in capsules and one administered night and morning to each turkey for one week. Only one turkey showed symptoms of the disease at the time, and died ten days later. Whether or not the others were affected and amenable to the treatment is not known.

Dr. Salmon has also recommended Benzonaphthal—1 grain, Salicylate of Bismuth—1 grain. Hyposulphite of Sodium may be useful in doses of two to four grains, or Betol in the dose of one grain.

Any of these doses should be administered twice daily for some time, to birds weighing not less than four pounds. For birds under that size the dose should be decreased proportionately.

Treatment by injection through the rectum has been suggested, but by referring to Plate 1, Fig. 1, it will be seen that an injector thus introduced would follow the intestine and not enter the caeca. Even were this possible, the liver might be diseased and could not be reached.

SUMMARY.

Summarizing the most reasonable course to follow when the disease is known to exist is to separate from the flock any fowl showing the least symptom of disease. Place it where it may be treated, and if it does not respond to medicines, but continues failing, kill the bird without drawing blood and burn the carcass, then sterilize the coop where it has been kept with quick-lime, using a sufficient quantity to cover the ground. An easy way to prepare the lime, so that it can be scattered, is to place it in a box and sprinkle water on it until the lime is reduced to a dusty powder. Old air-slacked lime loses its strength and is not so good.

Instead of this, a strong whitewash may be made, and with a broom or spray wet every part of the coop and floor.

Five cents worth of lime will disinfect a good-sized coop if thoroughly applied.

A solution of carbolic acid prepared by mixing 5 parts of the acid to 100 parts of water makes a good disinfecting solution and may be applied in the same manner as the whitewash, or chloride of lime, five ounces to one gallon of water is good.

Corrosive sublimate (mercuric chloride) in a strength of one ounce to about eight gallons of water, is a strong disinfectant and may also be used as the preceding ones, but it is poisonous and must be handled with great care.

The habits of turkeys are peculiar. They are not so domesticated as other fowls and seem to thrive better when allowed to roam at will. They are particular and suspicious of strange food given them, making it difficult to administer medicines without confining them and using force.

Considering these peculiarities, an attempt to administer medicine while they run at large or to disinfect the premises, is impracticable, but lime should be freely used on the excreta beneath where they roost and on their feeding grounds.

When the disease becomes seriously destructive it is more than likely that all the flock are affected, although they do not show signs of it, and many may naturally recover. Such radical means as destroying all the remaining birds may be resorted to, then by disinfecting as thoroughly as possible and suspending the raising of turkeys for one year, will eradicate the infective agent.

Upon restocking, eggs from healthy fowls which are not too closely in-bred should be secured, and the young raised on a part of the premises least frequented by the old flock.

A little timely care and precaution may prevent further serious losses.

This bulletin is in a popular form, for the guidance of turkey breeders, so that they may recognize the disease as soon as it is discovered.

E. F. PERNOT.

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